References

[1] H. S. Chen, "Glassy metals", Reports on Progress in Physics **43**, 353–432 (1980).

[2] F. E. Luborsky, ed., *Amorphous metallic alloys*, Butterworths monographs in materials, Includes bibliographical references and indexes (Butterworths, London, 1983), 1534 pp.

[3] W. L. Johnson, "Bulk amorphous metalan emerging engineering material", JOM **54**, 40–43 (2002).

[4] W. L. Johnson, "Bulk glass-forming metallic alloys: science and technology", MRS Bulletin **24**, 42–56 (1999).

[5] R. Busch, "The thermophysical properties of bulk metallic glass-forming liquids", JOM **52**, 39–42 (2000).

[6] A. Inoue, "Bulk amorphous alloys", in *Amorphous and nanocrystalline materials* (Springer Berlin Heidelberg, 2001), pp. 1–51.

[7] J. F. Löffler, "Bulk metallic glasses", Intermetallics **11**, 529–540 (2003).

[8] W. Wang, C. Dong, and C. Shek, "Bulk metallic glasses", Materials Science and Engineering: R: Reports **44**, 45–89 (2004).

[9] M Miller and P Liaw, eds., *Bulk metallic glasses - an overview* (Springer US, 2008).

[10] W. H. Wang, "Bulk metallic glasses with functional physical properties", Advanced Materials **21**, 4524–4544 (2009).

[11] A. Inoue, "Stabilization of metallic supercooled liquid and bulk amorphous alloys", Acta Materialia **48**, 279–306 (2000).

[12] W. KLEMENT, R. H. WILLENS, and P. DUWEZ, "Non-crystalline structure in solidified goldsilicon alloys", Nature **187**, 869–870 (1960).

[13] A. Inoue and N. Nishiyama, "Extremely low critical cooling rates of new pd-cu-p base amorphous alloys", Materials Science and Engineering: A **226228**, 401–405 (1997).

[14] J. F. Loffler, A. A. Kündig, and F. H. Dalla Torre, "Materials processing handbook", in , edited by J. R. Groza, J. F. Shackelford, E. J. Lavernia, and M. T. Powers (CRC Press, 2007) Chap. Rapid Solidification and Bulk Metallic Glasses Processing and Properties, pp. 17–1 –17–44.

[15] F Spaepen and D Turnbull, "Metallic glasses", Annual Review of Physical Chemistry **35**, 241–263 (1984).

[16] F. H. Stillinger, "A topographic view of supercooled liquids and glass formation", Science **267**, 1935–1939 (1995).

[17] R. Busch, E. Bakke, and W. L. Johnson, "On the glass forming ability of bulk metallic glasses", Materials Science Forum **235238**, 327–336 (1996).

[18] C. A. Angell, "Formation of glasses from liquids and biopolymers", Science **267**, 1924–1935 (1995).

[19] L.-M. Martinez and C. A. Angell, "A thermodynamic connection to the fragility of glass-forming liquids", Nature **410**, 663–667 (2001).

[20] T. Shindo, Y. Waseda, and A. Inoue, "Prediction of critical compositions for bulk glass formation in la-based, cu-based and zr-based ternary alloys", MATERIALS TRANSACTIONS **44**, 351–357 (2003).

[21] D. B. Miracle, "A structural model for metallic glasses", Nature Materials **3**, 697–702 (2004).

[22] A. Takeuchi and A. Inoue, "Classification of bulk metallic glasses by atomic size difference, heat of mixing and period of constituent elements and its application to characterization of the main alloying element", MATERIALS TRANSACTIONS **46**, 2817–2829 (2005).

[23] D. Miracle, "The efficient cluster packing model an atomic structural model for metallic glasses", Acta Materialia **54**, 4317–4336 (2006).

[24] A. L. Greer and E. Ma, "Bulk metallic glasses: at the cutting edge of metals research", MRS Bulletin **32**, 611–619 (2007).

[25] Y. Waseda, H.-S. Chen, K. Thomas Jacob, and H. Shibata, "On the glass forming ability of liquid alloys", Science and Technology of Advanced Materials **9**, 023003 (2008).

[26] B. YANG, Y. DU, and Y. LIU, "Recent progress in criterions for glass forming ability", Transactions of Nonferrous Metals Society of China **19**, 78–84 (2009).

[27] L. Yang, G. Q. Guo, L. Y. Chen, C. L. Huang, T. Ge, D. Chen, P. K. Liaw, K. Saksl, Y. Ren, Q. S. Zeng, B. LaQua, F. G. Chen, and J. Z. Jiang, "Atomic-scale mechanisms of the glass-forming ability in metallic glasses", Physical Review Letters **109**, 105502 (2012).

[28] Y. Cheng and E. Ma, "Atomic-level structure and structureproperty relationship in metallic glasses", Progress in Materials Science **56**, 379–473 (2011).

[29] L. Berthier and G. Biroli, "Theoretical perspective on the glass transition and amorphous materials", Reviews of Modern Physics **83**, 587–645 (2011).

[30] N. A. Mauro, M. Blodgett, M. L. Johnson, A. J. Vogt, and K. F. Kelton, "A structural signature of liquid fragility", Nature Communications **5**, `10.1038/ncomms5616` (2014).

[31] Y. C. Hu, F. X. Li, M. Z. Li, H. Y. Bai, and W. H. Wang, "Five-fold symmetry as indicator of dynamic arrest in metallic glass-forming liquids", Nature Communications **6**, `10.1038/ncomms9310` (2015).

[32] Z. W. Wu, M. Z. Li, W. H. Wang, and K. X. Liu, “Hidden topological order and its correlation with glass-forming ability in metallic glasses”, Nature Communications **6**, 10.1038/ncomms7035 (2015).

[33] K. F. Kelton, “Kinetic and structural fragilitya correlation between structures and dynamics in metallic liquids and glasses”, Journal of Physics: Condensed Matter **29**, 023002 (2016).

[34] R. Busch and I. Gallino, “Kinetics, thermodynamics, and structure of bulk metallic glass forming liquids”, JOM **69**, 2178–2186 (2017).

[35] Y. T. Sun, H. Y. Bai, M. Z. Li, and W. H. Wang, “Machine learning approach for prediction and understanding of glass-forming ability”, The Journal of Physical Chemistry Letters **8**, 3434–3439 (2017).

[36] A. K. Gangopadhyay, C. E. Pueblo, and K. F. Kelton, “Link between volume, thermal expansion, and bulk metallic glass formability”, Physical Review Materials **4**, 095602 (2020).

[37] K. F. Kelton, “A perspective on metallic liquids and glasses”, Journal of Applied Physics **134**, 10.1063/5.0144250 (2023).

[38] P. J. Desre, “On the effect of the number of components on glass-forming ability of alloys from the liquid state: application to the new generation of multicomponent bulk glasses”, Materials Transactions, JIM **38**, 583–588 (1997).

[39] Z. Lu and C. Liu, “A new glass-forming ability criterion for bulk metallic glasses”, Acta Materialia **50**, 3501–3512 (2002).

[40] Z. P. Lu and C. T. Liu, “Glass formation criterion for various glass-forming systems”, Physical Review Letters **91**, 115505 (2003).

[41] G. Shao, B. Lu, Y. Liu, and P. Tsakiropoulos, “Glass forming ability of multicomponent metallic systems”, Intermetallics **13**, 409–414 (2005).

[42] A. Inoue, B. Shen, and A. Takeuchi, "Developments and applications of bulk glassy alloys in late transition metal base system", MATERIALS TRANSACTIONS **47**, 1275–1285 (2006).

[43] Z. Lu, H. Bei, and C. Liu, "Recent progress in quantifying glass-forming ability of bulk metallic glasses", Intermetallics **15**, 618–624 (2007).

[44] W. Liu, H. Zhang, A. Wang, H. Li, and Z. Hu, "New criteria of glass forming ability, thermal stability and characteristic temperatures for various bulk metallic glass systems", Materials Science and Engineering: A **459**, 196–203 (2007).

[45] O. N. Senkov, "Correlation between fragility and glass-forming ability of metallic alloys", Physical Review B **76**, 104202 (2007).

[46] S. Guo, Z. Lu, and C. Liu, "Identify the best glass forming ability criterion", Intermetallics **18**, 883–888 (2010).

[47] M. Falcão de Oliveira, "A simple criterion to predict the glass forming ability of metallic alloys", Journal of Applied Physics **111**, 10.1063/1.3676196 (2012).

[48] L. Peng, Z. Long, and M. Zhao, "Determination of glass forming ability of bulk metallic glasses based on machine learning", Computational Materials Science **195**, 110480 (2021).

[49] S. A. Kube, S. Sohn, R. Ojeda-Mota, T. Evers, W. Polsky, N. Liu, K. Ryan, S. Rinehart, Y. Sun, and J. Schroers, "Compositional dependence of the fragility in metallic glass forming liquids", Nature Communications **13**, 10.1038/s41467-022-31314-3 (2022).

[50] H. W. Sheng, W. K. Luo, F. M. Alamgir, J. M. Bai, and E. Ma, "Atomic packing and short-to-medium-range order in metallic glasses", Nature **439**, 419–425 (2006).

[51] Y. Li, Q. Guo, J. A. Kalb, and C. V. Thompson, "Matching glass-forming ability with the density of the amorphous phase", Science **322**, 1816–1819 (2008).

[52] K. Lad, "Correlation between atomic-level structure, packing efficiency and glass-forming ability in cuzr metallic glasses", Journal of Non-Crystalline Solids **404**, 55–60 (2014).

[53] F. Zhang, M. Ji, X.-W. Fang, Y. Sun, C.-Z. Wang, M. I. Mendelev, M. Kramer, R. E. Napolitano, and K.-M. Ho, "Composition-dependent stability of the medium-range order responsible for metallic glass formation", Acta Materialia **81**, 337–344 (2014).

[54] A. Gangopadhyay and K. Kelton, "Recent progress in understanding high temperature dynamical properties and fragility in metallic liquids, and their connection with atomic structure", Journal of Materials Research **32**, 2638–2657 (2017).

[55] T. S. Ingebrigtsen, T. B. Schrøder, and J. C. Dyre, "What is a simple liquid?", Physical Review X **2**, 011011 (2012).

[56] J. C. Dyre, "Simple liquids quasiuniversality and the hard-sphere paradigm", Journal of Physics: Condensed Matter **28**, 323001 (2016).

[57] M. Canales and J. A. Padró, "Dynamic properties of lennard-jones fluids and liquid metals", Physical Review E **60**, 551–558 (1999).

[58] W. A. Harrison, *Pseudopotentials in the theory of metals* (Academic Press, London, 1966).

[59] J. A. Alonso, *Electrons in metals and alloys*, edited by N. H. March, Includes bibliographical references (pages 563-592) and index (Academic Press, London, 1989), 1603 pp.

[60] J. Hafner, *From hamiltonians to phase diagrams* (Springer Berlin Heidelberg, 1987).

[61] E. S. Kryachko and E. V. Ludeña, "Density functional theory: foundations reviewed", Physics Reports **544**, 123–239 (2014).

[62] M. Hasegawa and M. Watabe, "Theory of thermodynamic properties of liquid metals", Journal of the Physical Society of Japan **36**, 1510–1515 (1974).

[63] J. Hafner, "Structure and thermodynamics of liquid metals and alloys", Physical Review A **16**, 351–364 (1977).

[64] J. M. Wills and W. A. Harrison, "Interionic interactions in transition metals", Physical Review B **28**, 4363–4373 (1983).

[65] M. M. G. Alemany, C. Rey, and L. J. Gallego, "Transport coefficients of liquid transition metals: a computer simulation study using the embedded atom model", The Journal of Chemical Physics **109**, 5175–5176 (1998).

[66] J. L. Bretonnet and A. Derouiche, "Variational thermodynamic calculations for liquid transition metals", Physical Review B **43**, 8924–8929 (1991).

[67] J. L. Bretonnet and M. Silbert, "Interionic interactions in transition metals. application to vanadium", Physics and Chemistry of Liquids **24**, 169–176 (1992).

[68] L. Pollack, J. P. Perdew, J. He, M. Marques, F. Nogueira, and C. Fiolhais, "Tests of a density-based local pseudopotential for sixteen simple metals", Physical Review B **55**, 15544–15551 (1997).

[69] K. N. Lad and A. Pratap, "Phonon dispersion in amorphous zrni alloys", Physica B: Condensed Matter **334**, 135–146 (2003).

[70] J. Li, X. Dai, S. Liang, K. Tai, Y. Kong, and B. Liu, "Interatomic potentials of the binary transition metal systems and some applications in materials physics", Physics Reports **455**, 1–134 (2008).

[71] N Dubinin, "Correction to the wills-harrison approach: influence on the fe-based liquid alloys thermodynamics", Journal of Physics: Conference Series **936**, 012006 (2017).

[72] N. E. Dubinin, G. M. Bhuiyan, and F. I. Abbas, "Effective willsharrison pair interaction in liquid au", Russian Metallurgy (Metally) **2019**, 835–837 (2019).

[73] H Itoh, I Yokoyama, and Y Waseda, "Thermodynamic properties of liquid transition metals using simple model theories", Journal of Physics F: Metal Physics **16**, L113–L119 (1986).

[74] N. Singh and S. P. Singh, "Phonon spectra and isothermal elastic constants forf-shell metals: a dynamical treatment", Physical Review B **42**, 1652–1658 (1990).

[75] C. Pandya, P. Vyas, T. Pandya, N. Rani, and V. Gohel, "An improved lattice mechanical model for fcc transition metals", Physica B: Condensed Matter **307**, 138–149 (2001).

[76] C Cabrillo, F. J. Bermejo, A Maira-Vidal, R Fernández-Perea, S. M. Bennington, and D Martin, "Microscopic dynamics in simple liquids: a clue to understanding the basic thermodynamics of the liquid state", Journal of Physics: Condensed Matter **16**, S309–S325 (2004).

[77] N. E. Dubinin, L. D. Son, and N. A. Vatolin, "The willsharrison approach to the thermodynamics of binary liquid transition-metal alloys", Journal of Physics: Condensed Matter **20**, 114111 (2008).

[78] A. M. Vora and A. L. Gandhi, "Collective dynamics of zr-based bulk metallic glasses", Chinese Journal of Physics **62**, 284–295 (2019).

[79] A. B. Patel and H. Sheng, "Structure and atomic transport of liquid titanium from a pair potential model", Physical Review B **102**, 064101 (2020).

[80] N. Dubinin and R. Ryltsev, "Effective pair interactions and structure in liquid noble metals within wills-harrison and bretonnet-silbert models", Metals **11**, 1115 (2021).

[81] H. Mori, "Transport, collective motion, and brownian motion", Progress of Theoretical Physics **33**, 423–455 (1965).

[82] R Kubo, “The fluctuation-dissipation theorem”, Reports on Progress in Physics **29**, 255–284 (1966).

[83] L. Glass and S. A. Rice, “Unified approximation for the velocity autocorrelation function and the structure function of a simple liquid”, Physical Review **176**, 239–249 (1968).

[84] K. N. Lad and A. Pratap, “Velocity autocorrelation function for simple liquids and its application to liquid metals and alloys”, Physical Review E **70**, 051201 (2004).

[85] K. N. Lad and A. Pratap, “Atomic dynamics in liquid alkali metals at the melting point”, Physical Review B **73**, 054204 (2006).

[86] J. K. Percus and G. J. Yevick, “Analysis of classical statistical mechanics by means of collective coordinates”, Physical Review **110**, 1–13 (1958).

[87] J. A. Barker and D. Henderson, “What is liquid? understanding the states of matter”, Reviews of Modern Physics **48**, 587–671 (1976).

[88] N. H. March and M. P. Tosi, *Atomic dynamics in liquids* (Macmillan Education UK, 1976).

[89] Y. Waseda, *The structure of non-crystalline materials, Liquids and amorphous solids*, Advanced book program, Literaturverz. S. 307 - 315 (McGraw-Hill International Book Co., New York; London, 1980), 326 pp.

[90] U. Balucani and M. Zoppi, *Dynamics of the liquid state* (Oxford University PressOxford, Jan. 1995).

[91] P. Egelstaff, *An introduction to the liquid state*, Description based upon print version of record (Elsevier Science, Burlington, 2012), 253 pp.

[92] J.-P. Hansen, *Theory of simple liquids, With applications to soft matter*, edited by I. R. McDonald, Fourth edition, Description based on publisher supplied metadata and other sources. (Elsevier, Amsterdam, 2013), 1619 pp.

[93] J. D. BERNAL and J. MASON, "Packing of spheres: co-ordination of randomly packed spheres", Nature **188**, 910–911 (1960).

[94] J. L. Finney and J. D. Bernal, "Random packings and the structure of simple liquids. i. the geometry of random close packing", Proceedings of the Royal Society of London. A. Mathematical and Physical Sciences **319**, 479–493 (1970).

[95] P. H. GASKELL, "A new structural model for transition metalmetalloid glasses", Nature **276**, 484–485 (1978).

[96] G. A. Mansoori, N. F. Carnahan, K. E. Starling, and T. W. Leland, "Equilibrium thermodynamic properties of the mixture of hard spheres", The Journal of Chemical Physics **54**, 1523–1525 (1971).

[97] A. Takeuchi and A. Inoue, "Calculations of mixing enthalpy and mismatch entropy for ternary amorphous alloys", Materials Transactions, JIM **41**, 1372–1378 (2000).

[98] J. D. Hoffman, "Thermodynamic driving force in nucleation and growth processes", The Journal of Chemical Physics **29**, 1192–1193 (1958).

[99] D. R. H. Jones and G. A. Chadwick, "An expression for the free energy of fusion in the homogeneous nucleation of solid from pure melts", Philosophical Magazine **24**, 995–998 (1971).

[100] C. V. Thompson and F. Spaepen, "On the approximation of the free energy change on crystallization", Acta Metallurgica **27**, 1855–1859 (1979).

[101] H. Singh and A. Holz, "Stability limit of supercooled liquids", Solid State Communications **45**, 985–988 (1983).

[102] K. Dubey and P. Ramachandrarao, "On the free energy change accompanying crystallisation of undercooled melts", Acta Metallurgica **32**, 91–96 (1984).

[103] K. N. Lad, A. Pratap, and K. G. Raval, "Estimation of the free energy change on crystallization of multicomponent glass forming alloys", Journal of Materials Science Letters **21**, 1419–1422 (2002).

[104] K. Mondal, U. K. Chatterjee, and B. S. Murty, "Gibbs free energy for the crystallization of glass forming liquids", Applied Physics Letters **83**, 671–673 (2003).

[105] K. N. Lad, K. Raval, and A. Pratap, "Estimation of gibbs free energy difference in bulk metallic glass forming alloys", Journal of Non-Crystalline Solids **334335**, 259–262 (2004).

[106] X. Ji and Y. Pan, "Gibbs free energy difference in metallic glass forming liquids", Journal of Non-Crystalline Solids **353**, 2443–2446 (2007).

[107] H. Dhurandhar, T. L. S. Rao, K. N. Lad, and A. Pratap, "Gibbs free energy for the crystallization of metallic glass-forming alloys from an undercooled liquid", Philosophical Magazine Letters **88**, 239–249 (2008).

[108] M. Poulain, "Heavy metal fluoride glasses: a tutorial review", APL Photonics **9**, `10.1063/5.0226668` (2024).

[109] W. G. Jordan and A. Jha, "A review of the role of dsc analysis in the design of fluorozirconate glasses for fibre optic applications", Journal of Thermal Analysis **42**, 759–770 (1994).

[110] H. E. Kissinger, "Reaction kinetics in differential thermal analysis", Analytical Chemistry **29**, 1702–1706 (1957).

[111] J. A. Augis and J. E. Bennett, "Calculation of the avrami parameters for heterogeneous solid state reactions using a modification of the kissinger method", Journal of Thermal Analysis **13**, 283–292 (1978).

[112] A. Einstein, Annalen der Physik **322**, 549–560 (1905).

[113] M. von Smoluchowski, Annalen der Physik **326**, 756–780 (1906).

[114] P. Langevin, "On the theory of brownian motion.", CR Acad Sci (Paris) **146**, 530 (1908).

[115] S. Chandrasekhar, "Stochastic problems in physics and astronomy", Reviews of Modern Physics **15**, 1–89 (1943).

[116] T. Franosch, M. Grimm, M. Belushkin, F. M. Mor, G. Foffi, L. Forró, and S. Jeney, "Resonances arising from hydrodynamic memory in brownian motion", Nature **478**, 85–88 (2011).

[117] S. Kheifets, A. Simha, K. Melin, T. Li, and M. G. Raizen, "Observation of brownian motion in liquids at short times: instantaneous velocity and memory loss", Science **343**, 1493–1496 (2014).

[118] A. V. Straube, B. G. Kowalik, R. R. Netz, and F. Höfling, "Rapid onset of molecular friction in liquids bridging between the atomistic and hydrodynamic pictures", Communications Physics **3**, `10.1038/s42005-020-0389-0` (2020).

[119] J. Kirkwood, "The statistical mechanical theory of transport processes i. general theory", The Journal of Chemical Physics **14**, 180–201 (1946).

[120] G. Uhlenbeck and L. Ornstein, "On the theory of the brownian motion", Physical Review **36**, 823–841 (1930).

[121] V. Sears, "The itinerant oscillator model of liquids", Proceedings of the Physical Society **86**, 953–964 (1965).

[122] P. Damle, A. Sjlander, and K. Singwi, "Itinerant-oscillator model of liquids", Physical Review **165**, 277–283 (1968).

[123] A. Rahman, K. Singwi, and A. Sjölander, "Stochastic model of a liquid and cold neutron scattering. ii", Physical Review **126**, 997–1004 (1962).

[124] V. Ardente, G. Nardelli, and L. Reatto, "Slow-neutron scattering by liquids: a hindered-translator model", Physical Review **148**, 124–138 (1966).

[125] R. Zwanzig, "On the relation between self-diffusion and viscosity of liquids", The Journal of Chemical Physics **79**, 4507–4508 (1983).

[126] T. Keyes, "Instantaneous normal mode approach to liquid state dynamics", Journal of Physical Chemistry A **101**, 2921–2930 (1997).

[127] J. Cao and G. Voth, "A theory for time correlation functions in liquids", The Journal of Chemical Physics **103**, 4211–4220 (1995).

[128] E. Rabani, J. Gezelter, and B. Berne, "Calculating the hopping rate for self-diffusion on rough potential energy surfaces: cage correlations", Journal of Chemical Physics **107**, 6867–6876 (1997).

[129] J. Gezelter, E. Rabani, and B. Berne, "Can imaginary instantaneous normal mode frequencies predict barriers to self-diffusion?", Journal of Chemical Physics **107**, 4618–4627 (1997).

[130] J. Gezelter, E. Rabani, and B. Berne, J. Chem. Phys. **109** (1998).

[131] D. Wallace, "Liquid dynamics theory of the velocity autocorrelation function and self-diffusion", Physical Review E - Statistical Physics, Plasmas, Fluids, and Related Interdisciplinary Topics **58**, 538–545 (1998).

[132] D. Chisolm, E. Clements, and C. Wallace, "Mean-atom-trajectory model for the velocity autocorrelation function of monatomic liquids", Physical Review E - Statistical Physics, Plasmas, Fluids, and Related Interdisciplinary Topics **63**, `10.1103/PhysRevE.63.031204` (2001).

[133] D. Wallace, G. De Lorenzi-Venneri, and E. Chisolm, "Atomic motion from the mean square displacement in a monatomic liquid", Journal of Physics Condensed Matter **28**, `10.1088/0953-8984/28/18/185101` (2016).

[134] M. Vergeles and G. Szamel, "A theory for self-diffusion in liquids", Journal of Chemical Physics **110**, 3009–3022 (1999).

[135] S. Rice and P. Gray, The Statistical Mechanics of Simple Liquids (1965).

[136] J. Frenkel, *Kinetic theory of liquids* (Dover Publications, New York, 1955), p. 138.

[137] K. Trachenko and V. Brazhkin, "Understanding the problem of glass transition on the basis of elastic waves in a liquid", Journal of Physics Condensed Matter **21**, 10.1088/0953-8984/21/42/425104 (2009).

[138] T. Narumi, S. Franklin, K. Desmond, M. Tokuyama, and E. Weeks, "Spatial and temporal dynamical heterogeneities approaching the binary colloidal glass transition", Soft Matter **7**, 1472–1482 (2011).

[139] B. Nijboer and A. Rahman, "Time expansion of correlation functions and the theory of slow neutron scattering", Physica **32**, 415–432 (1966).

[140] J.-P. Hansen and I. McDonald, *Theory of simple liquids* (2006).

[141] .

[142] B. Berne, J. Boon, and S. Rice, "On the calculation of autocorrelation functions of dynamical variables", The Journal of Chemical Physics **45**, 1086–1096 (1966).

[143] S. Bembenek and G. Szamel, "The role of attractive interactions in self-diffusion", Journal of Physical Chemistry B **104**, 10647–10652 (2000).

[144] S. Toxvaerd and J. Dyre, "Communication: shifted forces in molecular dynamics", Journal of Chemical Physics **134**, 10.1063/1.3558787 (2011).

[145] J. Casas, D. González, L. González, M. Alemany, and L. Gallego, "Density fluctuations and single-particle dynamics in liquid lithium", Physical Review B - Condensed Matter and Materials Physics **62**, 12095–12106 (2000).

[146] K. Hoshino, F. Shimojo, and S. Munejiri, "Mode-coupling analyses of atomic dynamics for liquid ge, sn and na", Journal of the Physical Society of Japan **71**, 119–124 (2002).

[147] N. Ashcroft, "Electron-ion pseudopotentials in metals", Physics Letters **23**, 48–50 (1966).

[148] S. Ichimaru and K. Utsumi, "Analytic expression for the dielectric screening function of strongly coupled electron liquids at metallic and lower densities", Physical Review B **24**, 7385–7388 (1981).

[149] J. Boon and S. Yip, Molecular Hydrodynamics (1980).

[150] T. Geszti, "Waves and oscillations in the atomic dynamics of liquid metals", Journal of Physics C: Solid State Physics **9**, L263–L265 (1976).

[151] D. Schiff, "Computer "experiments" on liquid metals", Physical Review **186**, 151–159 (1969).

[152] S. Kambayashi and Y. Hiwatari, "Molecular-dynamics study of dynamical properties of dense soft-sphere fluids: the role of short-range repulsion of the intermolecular potential", Physical Review E **49**, 1251–1259 (1994).

[153] N. Anento, J. Padró, and M. Canales, "Dynamic properties of simple liquids: dependence on the softness of the potential core", Journal of Chemical Physics **111**, 10210–10216 (1999).

[154] P. Español and I. Zúñiga, "Force autocorrelation function in brownian motion theory", The Journal of Chemical Physics **98**, 574–580 (1993).

[155] D. Lesnicki, R. Vuilleumier, A. Carof, and B. Rotenberg, "Molecular hydrodynamics from memory kernels", Physical Review Letters **116**, `10.1103/PhysRevLett.116.147804` (2016).

[156] G. Goodyear, R. Larsen, and R. Stratt, "Molecular origin of friction in liquids", Physical Review Letters **76**, 243–246 (1996).

[157] S. Bellissima, M. Neumann, E. Guarini, U. Bafile, and F. Barocchi, "Time dependence of the velocity autocorrelation function of a fluid: an eigenmode analysis of dynamical processes", Physical Review E - Statistical, Nonlinear, and Soft Matter Physics **92**, `10.1103/PhysRevE.92.042166` (2015).

[158] T.-M. Wu and S.-F. Tsay, "Instantaneous normal mode analysis of liquid na", Journal of Chemical Physics **105**, 9281–9287 (1996).

[159] K. N. Lad, M. K. Patel, and A. Pratap, "Brownian motion with time-dependent friction and single-particle dynamics in liquids", Physical Review E **105**, 064107 (2022).

[160] V. Lisý and J. Tóthová, "Comment on brownian motion with time-dependent friction and single-particle dynamics in liquids", Physical Review E **108**, 036107 (2023).

[161] K. N. Lad, M. K. Patel, A. Pratap, and J. N. Pandya, "Reply to comment on brownian motion with time-dependent friction and single-particle dynamics in liquids", Physical Review E **108**, 036108 (2023).

[162] H. Kang and C. An, "Differentiation formulas of some hypergeometric functions with respect to all parameters", Applied Mathematics and Computation **258**, 454–464 (2015).

[163] Y. Luo and C. Zeng, "Negative friction and mobilities induced by friction fluctuation", Chaos **30**, `10.1063/1.5144556` (2020).

[164] S. Plimpton, "Fast parallel algorithms for short-range molecular dynamics", Journal of Computational Physics **117**, 1–19 (1995).

[165] M. Mendelev, M. Kramer, C. Becker, and M. Asta, "Analysis of semi-empirical interatomic potentials appropriate for simulation of crystalline and liquid al and cu", Philosophical Magazine **88**, 1723–1750 (2008).

[166] M. Mendelev, M. Kramer, S. Hao, K. Ho, and C. Wang, "Development of interatomic potentials appropriate for simulation of liquid and glass properties of nizr2 alloy", Philosophical Magazine **92**, 4454–4469 (2012).

[167] M. Mendelev, S. Han, D. Srolovitz, G. Ackland, D. Sun, and M. Asta, "Development of new interatomic potentials appropriate for crystalline and liquid iron", Philosophical Magazine **83**, 3977–3994 (2003).

[168] A. Inoue, *Bulk amorphous alloys, Preparation and fundamental characteristics*, Materials Science Foundations 4, Includes bibliographical references and index. - Print version record (Trans Tech Publications, Zürich, 1998), 1116 pp.

[169] Y. Q. Cheng, E. Ma, and H. W. Sheng, "Atomic level structure in multicomponent bulk metallic glass", Physical Review Letters **102**, 245501 (2009).

[170] J. Bhatt, W. Jiang, X. Junhai, W. Qing, C. Dong, and B. Murty, "Optimization of bulk metallic glass forming compositions in zrcual system by thermodynamic modeling", Intermetallics **15**, 716–721 (2007).

[171] A. Zhang, D. Chen, and Z. Chen, "Bulk metallic glass-forming region of cuzr binary and cuzr based multicomponent alloy systems", Journal of Alloys and Compounds **477**, 432–435 (2009).

[172] J. L. Finney, "Modelling the structures of amorphous metals and alloys", Nature **266**, 309–314 (1977).

[173] J. L. Lebowitz, "Exact solution of generalized percus-yevick equation for a mixture of hard spheres", Physical Review **133**, A895–A899 (1964).

[174] J. C. Bendert, A. K. Gangopadhyay, N. A. Mauro, and K. F. Kelton, "Volume expansion measurements in metallic liquids and their relation to fragility and glass forming ability: an energy landscape interpretation", Physical Review Letters **109**, 185901 (2012).

[175] Y. Li, S. J. Poon, G. J. Shiflet, J. Xu, D. H. Kim, and J. F. Löffler, "Formation of bulk metallic glasses and their composites", MRS Bulletin **32**, 624–628 (2007).

[176] M. Ashby and A. Greer, "Metallic glasses as structural materials", Scripta Materialia **54**, Viewpoint set no: 37. On mechanical behavior of metallic glasses, 321–326 (2006).

[177] A. T. Patel, H. R. Shevde, and A. Pratap, "Thermodynamics of zr52.5cu17.9ni14.6al10ti5 bulk metallic glass forming alloy", Journal of Thermal Analysis and Calorimetry **107**, 167–170 (2011).

[178] J. Qiao, Q. Wang, J. Pelletier, H. Kato, R. Casalini, D. Crespo, E. Pineda, Y. Yao, and Y. Yang, "Structural heterogeneities and mechanical behavior of amorphous alloys", Progress in Materials Science **104**, 250–329 (2019).

[179] W. H. Wang, "Dynamic relaxations and relaxation-property relationships in metallic glasses", Progress in Materials Science **106**, 100561 (2019).

[180] Q. Jiang, X. Wang, X. Nie, G. Zhang, H. Ma, H.-J. Fecht, J. Bendnarcik, H. Franz, Y. Liu, Q. Cao, and J. Jiang, "Zr(cu,ag)al bulk metallic glasses", Acta Materialia **56**, 1785–1796 (2008).

[181] V. Ponnambalam, S. J. Poon, and G. J. Shiflet, "Fe-based bulk metallic glasses with diameter thickness larger than one centimeter", Journal of Materials Research **19**, 13201323 (2004).

[182] C.-L. Dai, H. Guo, Y. Shen, Y. Li, E. Ma, and J. Xu, "A new centimeterdiameter cu-based bulk metallic glass", Scripta Materialia **54**, 1403–1408 (2006).

[183] Q. Zheng, J. Xu, and E. Ma, "High glass-forming ability correlated with fragility of mgcu(ag)gd alloys", Journal of Applied Physics **102**, 113519 (2007).

[184] Q. Jiang, G. Zhang, L. Yang, X. Wang, K. Saksl, H. Franz, R. Wunderlich, H. Fecht, and J. Jiang, "La-based bulk metallic glasses with critical diameter up to 30mm", Acta Materialia **55**, 4409–4418 (2007).

[185] S. Zhu, X. Wang, and A. Inoue, "Glass-forming ability and mechanical properties of ti-based bulk glassy alloys with large diameters of up to 1cm", Intermetallics **16**, 1031–1035 (2008).

[186] W. L. Johnson, "Fundamental aspects of bulk metallic glass formation in multicomponent alloys", Materials Science Forum **225**, 35–50 (1996).

[187] Z. Lu, C. Liu, and Y. Dong, "Effects of atomic bonding nature and size mismatch on thermal stability and glass-forming ability of bulk metallic glasses", Journal of non-crystalline solids **341**, 93–100 (2004).

[188] W. K. Luo, H. W. Sheng, F. M. Alamgir, J. M. Bai, J. H. He, and E. Ma, "Icosahedral short-range order in amorphous alloys", Phys. Rev. Lett. **92**, 145502 (2004).

[189] T. Wada, F. Qin, X. Wang, M. Yoshimura, A. Inoue, N. Sugiyama, R. Ito, and N. Matsushita, "Formation and bioactivation of zr-al-co bulk metallic glasses", Journal of Materials Research **24**, 29412948 (2009).

[190] C. Chattopadhyay, K. S. N. S. Idury, J. Bhatt, K. Mondal, and B. S. Murty, "Critical evaluation of glass forming ability criteria", Materials Science and Technology **32**, 380–400 (2016).

[191] J. Zhu, C. Wang, J. Han, S. Yang, G. Xie, H. Jiang, Y. Chen, and X. Liu, "Formation of zr-based bulk metallic glass with large amount of yttrium addition", Intermetallics **92**, 55–61 (2018).

[192] D. V. Louzguine and A. Inoue, "Electronegativity of the constituent rare-earth metals as a factor stabilizing the supercooled liquid region in al-based metallic glasses", Applied Physics Letters **79**, 3410–3412 (2001).

[193] M. Malekan, R. Rashidi, and S. G. Shabestari, "Mechanical properties and crystallization kinetics of er-containing cuzral bulk metallic glasses with excellent glass forming ability", Vacuum **174**, 109223 (2020).

[194] Y. Zhang, M. X. Pan, D. Q. Zhao, R. J. Wang, and W. H. Wang, "Formation of zr-based bulk metallic glasses from low purity of materials by yttrium addition", Materials Transactions, JIM **41**, 1410–1414 (2000).

[195] S. Fang, X. Xiao, L. Xia, W. Li, and Y. Dong, "Relationship between the widths of supercooled liquid regions and bond parameters of mg-based bulk metallic glasses", Journal of Non-Crystalline Solids **321**, 120–125 (2003).

[196] K. Zhou, Y. Liu, S. Pang, and T. Zhang, "Formation and properties of centimeter-size zr–ti–cu–al–y bulk metallic glasses as potential biomaterials", Journal of Alloys and Compounds **656**, 389–394 (2016).

[197] L.-M. Wang, C. A. Angell, and R. Richert, "Fragility and thermodynamics in nonpolymeric glass-forming liquids", The Journal of Chemical Physics **125**, 10.1063/1.2244551 (2006).

[198] Q. Gao and Z. Jian, "Predicting the thermodynamic ideal glass transition temperature in glass-forming liquids", Materials **13**, 10.3390/ma13092151 (2020).

[199] X. K. Xi, D. Q. Zhao, M. X. Pan, W. H. Wang, Y. Wu, and J. J. Lewandowski, "Fracture of brittle metallic glasses: brittleness or plasticity", Phys. Rev. Lett. **94**, 125510 (2005).

[200] S. Fang, X. Xiao, L. Xia, Q. Wang, W. Li, and Y. Dong, "Effects of bond parameters on the widths of supercooled liquid regions of ferrous bmgs", Intermetallics **12**, 1069–1072 (2004).

[201] D. Perera, "Compilation of the fragility parameters for several glass-forming metallic alloys", Journal of Physics: Condensed Matter **11**, 3807 (1999).

[202] L. Battezzati and M. Baricco, "An experimental study of thermodynamic properties in a zblan glass-forming system", Materials Science and Engineering: A **133**, Proceedings of the Seventh International Conference on Rapidly Quenched Materials, 584–587 (1991).

[203] M. Poulain, M. Poulain, and J. Lucas, "Verres fluores au tetrafluorure de zirconium proprietes optiques d'un verre dope au nd3+", Materials Research Bulletin **10**, 243–246 (1975).

[204] J.-L. Adam, "Fluoride glass research in france: fundamentals and applications", Journal of Fluorine Chemistry **107**, 265–270 (2001).

[205] C. T. Moynihan and S. Loehr, "Chemical durability of fluoride glasses", in Halide glasses v, Vol. 32, Materials Science Forum (Jan. 1988), pp. 243–253.

[206] D Piatkowski, K Wisniewski, M Rozanski, C. Koepke, M Kaczkan, M Klimczak, R Piramidowicz, and M Malinowski, "Excited state absorption spectroscopy of zblan:ho3+ glassexperiment and simulation", Journal of Physics: Condensed Matter **20**, 155201 (2008).

[207] C. Chen, Y. Wu, and L. Hwa, "Temperature dependence of elastic properties of zblan glasses", Materials Chemistry and Physics **65**, 306–309 (2000).

[208] P. Hart, G. X. Lu, and I. D. Aggarwal, "Nucleation and crystallization kinetics in a zblan glass", in Halide glasses v, Vol. 32, Materials Science Forum (Jan. 1988), pp. 179–184.

[209] P. B. Pandya, A. Pratap, et al., "Glass forming ability of zblan glass", Indian Journal of Pure & Applied Physics (IJPAP) **58**, 465–469 (2020).

[210] K. N. Lad, R. Savalia, A. Pratap, G. Dey, and S. Banerjee, "Isokinetic and isoconversional study of crystallization kinetics of a zr-based metallic glass", Thermochimica Acta **473**, 74–80 (2008).

[211] A. T. Patel and A. Pratap, "Kinetics of crystallization of zr52cu18ni14al10ti6 metallic glass", Journal of Thermal Analysis and Calorimetry J Therm Anal Calorim **107**, 159–165 (2012).

[212] J. Larmagnac, J. Grenet, and P. Michon, "Glass transition temperature dependence on heating rate and on ageing for amorphous selenium films", Journal of Non-Crystalline Solids **45**, 157–168 (1981).

[213] S. O. Kasap and C. Juhasz, "Kinematical transformations in amorphous selenium alloys used in xerography", Journal of Materials Science **21**, 1329–1340 (1986).

[214] N Mehta and A Kumar, "Applicability of kissingers relation in the determination of activation energy of glass transition process", J Optoelectron Adv Mater **7**, 1473–8 (2005).

[215] O. A. Lafi and M. M. Imran, "Compositional dependence of thermal stability, glass-forming ability and fragility index in some setesn glasses", Journal of Alloys and Compounds **509**, 5090–5094 (2011).