A Comprehensive Liquid Metal Thermophysical Property Database and Preliminary Statistical Calculation Models for Viscosity and Density

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The thermophysical properties of liquid metals are fundamental data for the production and design of metallic materials. However, the experimental data were distributed in vast literatures, systematic compilation of the data is extremely time-consuming. Most of the liquid metal databases cover only limited recordings of thermophysical properties. During the last several years, a very large and comprehensive thermophysical database for liquid metals and alloys was constructed. Currently the database covers more than 30 common metals and their alloys. It contains nearly 20,000 experimental viscosity data and more 17,000 experimental density data collected and digitized from open published studies. It also contains more than 100,000 liquidus temperature data derived from phase diagrams. The numbers of recordings are still growing, and the surface tension, thermal/electric conductivity data will be included in the future.

Based on the database, statistical calculation models for viscosity and density were established. The viscosity model was based on MYEGA equation, and the density model was based on constant thermal expansion coefficients and composition-dependent excess molar volume. Both models cover the pure metal and alloys of Ag, Al, Au, Bi, Cd, Co, Cr, Cu, Fe, Ga, Hg, In, K, Li, Mg, Mn, Mo, Na, Nb, Ni, Pb, Sb, Si, Sn, Ti, Tl, V, W, Zn and Zr. The models reproduce the experimental viscosity and density data very well. Together with the liquidus temperature data, the viscosity and density at liquidus temperature can be obtained. It was applied to Zr-Ti-Cu-Ni systems to correlate glass forming ability (GFA) with liquidus viscosity and density.