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Not flexible but reactive

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Despite its importance in high temperature processes (e.g. welding and coating), the wetting behavior of liquid metals on solid metals (or ceramics) at high temperatures remains poorly understood due to complex physiochemical processes e.g. surface oxidation, Marangoni flows, and interfacial reactions controlling the interfacial properties. Performing experiments above 1000℃ requires a strict control of the different phases (gas, liquid, solid) and therefore a complex machinery. It makes it an exciting engineering challenge but also limits the accessibility and interpretation of experimental results. To address these issues, we implemented a combined experimental and numerical study supported by a newly-designed thermo-optical dynamic wetting apparatus, in-situ observation and quenching of liquid/gas interfaces by a confocal laser scanning microscope, molecular dynamics, and computational fluid dynamics simulations. Our study comprehensively explores the high-temperature wetting behaviors across various systems, including non-reactive Al/Al2O3, dissolutive Cu/Ni and reactive Al/Ni systems. Key aspects investigated involve the evolution of oxides and Marangoni flow at liquid/gas interfaces, physiochemical interactions at liquid/solid interfaces and their impact on spreading dynamics.

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