Room-temperature reactive interactions between transition metal monoxides and silicon monoxide sols generated by laser ablation in liquid leading to the formation of silicides and silicates

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Colloidal nanoparticles (NPs) have applications in various fields, including material science, engineering, and chemistry. However, understanding their eventual reactivity at room temperature remains an ongoing challenge. So far, our recent study has reported the only room-temperature reactive interaction between LAL-induced TiO and SiO, resulting in the formation of the $TiSi_2$ phase [1]. This research aims to explore the key factors influencing the room-temperature reactivity of colloidal inorganic NPs. NPs of different metal monoxides (MnO, SiO, and Cu_2O) were prepared via laser ablation in liquids (water and ethanol). Their properties, such as particle size, zeta potential, phase composition, and photocatalytic activity, were examined. Additionally, mixed colloids were prepared by simply mixing individually prepared SiO with MnO and Cu_2O. Thus, two colloidal systems (MnO–SiO, Cu_2O–SiO) were examined to investigate their room-temperature reactivity. The measured zeta potentials indicate that all prepared colloids are unstable, suggesting high mutual attraction followed by reactive interaction. This hypothesis was confirmed through Raman, XP and XRD spectroscopy, which revealed the formation of manganese and copper silicides, and manganese silicate.

This newly observed phenomenon of reactive interaction of two different colloids allows the low-temperature preparation of difficult-to-achieve phases (e.g. silicides). Furthermore, it contributes to our comprehension of nanoparticle behaviour at room temperature and expands their potential applications across various disciplines.

References: [1] T. Křenek *et al.*, "A novel route of colloidal chemistry: room temperature reactive interactions between titanium monoxide and silicon monoxide sols produced by laser ablation in liquid resulting in the formation of titanium disilicide," *Dalt. Trans.*, vol. 51, no. 36, pp. 13831–13847, 2022, doi: 10.1039/d2dt02065c.