Microfluidic Synthesis and Surface Engineering of Colloidal Nanoparticles
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Sponsorship: Microchemical Systems Technology Center

Metal oxide colloidal particles such as silica (SiO$_2$) and titania (TiO$_2$) have many diverse applications ranging from catalysis, pigments and photonic band-gap materials to health care products. There has also been considerable research interest over the last decade in fabricating core-shell materials with tailored optical and surface properties. Core-shell particles such as titania-coated silica often exhibit improved physical and chemical properties over their single-component counterparts and hence are potentially useful over a broader range of applications. Newer methods of engineering such materials with controlled precision are required to overcome the difficulties with conventional production techniques, which are limited to multi-step batch processes. We have developed microfluidic routes for synthesis and surface-coating of colloidal silica and titania particles.

The chief advantages of a microfluidic platform are precise control over reactant addition and mixing and continuous operation. Microfluidic chemical reactors for the synthesis and overcoating of colloidal particles are shown in Figure 1a and Figure 1b, respectively [1-2]. Figure 2a is an SEM micrograph of silica particles synthesized in a microreactor (Figure 1a) operated in segmented gas-liquid flow mode. Figure 2b shows a silica nanoparticle coated with a thick shell of titania. We have also fabricated integrated devices combining synthesis and overcoating to enable continuous multi-step synthesis of core-shell particles.

REFERENCES: