A Top-down strategy of synthesizing FePt, Fe_3Pt alloy and Pt nanoparticles with controllable phase, structure and size for oxygen reduction reaction

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Laser ablation in liquid environment is deemed as a promising strategy for the synthesis of nanomaterials due to its simplicity, versatility and free of contamination and ligand. Most work has been carried out on synthesizing nanoparticles through single element targets in multiple sizes and shapes through this method. However, laser ablation generated bimetallic nanoparticles, in particular, Pt-M alloys which are favourable for fuel cell electrocatalysis and magnetism-related applications, are not well understood. Here, we investigate the generation of FePt and Fe_3Pt in deionized water and ethanol respectively. The relationship between nanoparticles characteristics including phase, structure and size corresponding with different solvents was studied through XRD, quantitative STEM-EDS, and TEM. By characterising the generated nanoparticles, we demonstrate that the solvent environment affects FePt nanoparticles' structure and phase evolution drastically. In the presence of ethanol, an alloy phase with slightly Pt enrichment was formed. While in water, severe surface segregation of Fe covering Pt enriched core is more favourable. Additionally, we also find a facile and free of contamination approach yielding monodisperse colloidal Pt particles with a diameter of 4.7 ± 0.3 nm though further UV laser irradiation. The material-specific findings based on our results show an opportunity of producing FePt alloy nanoparticles with controllable phase, structure and size and the top-down approach may be extendable to other Pt-M alloy (M: Cr, Ni) nanoparticles production.