

Room-temperature Coalescence of Metal Nanoparticles by Ligand Exchange with Tri-*n*-Octylphosphine Oxide and Subsequent Dipping into an Organic Solvent Containing a Sintering Agent

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Room-temperature (RT) coalescence of metal nanoparticles (NPs) is the remarkable technology in various fields such as flexible electronics and heterogeneous catalysts. In the RT coalescence of NPs, the metal surface is normally capped by ligands with a long alkyl chain to avoid their aggregation but the ligands must be effectively removed after the immobilization of NPs on the substrate. In this study, the RT coalescence of metal (Ag, Pd) NPs (diameter: ~6 nm) prepared by ligand exchange with tri-*n*-octylphosphine oxide (TOPO) was conducted using sintering agents, which promote the desorption of ligands from the metal surface.

The TOPO paste of Ag NPs was cast on the substrate (PET and glass) and they coalesced at RT by dipping into methanol containing cetyltrimethylammonium chloride (CTAC) as a sintering agent (Figure 1a). The resistivity of the obtained Ag thin film was $3.8 \times 10^{-5} \Omega \text{ m}$. The SEM image of the Ag thin film indicated that most of Ag NPs coalesced after the RT sintering (Figure 1b). In addition, porous Pd structures were obtained from the TOPO paste of Pd NPs by dipping into methanol containing KOH as a sintering agent. Their catalytic activities in the Suzuki coupling reaction increased with the increase of the KOH concentration in the sintering process (Figure 2).

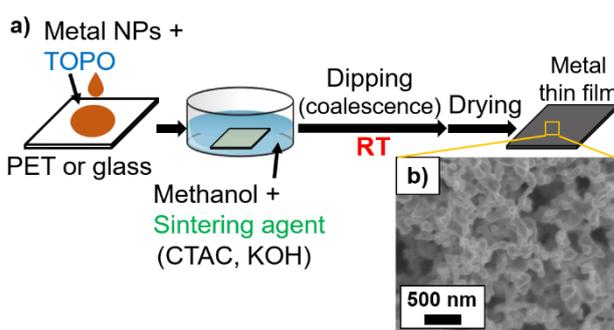


Figure 1. a) General procedure of RT coalescence and b) SEM image of the Ag thin film obtained by dipping into methanol containing CTAC.

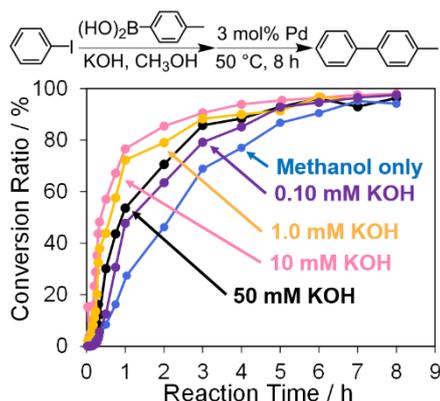


Figure 2. Conversion ratio against reaction time in the Suzuki reaction in the absence and presence of porous Pd structures prepared by various KOH concentrations.