Polyphosphazenes as solid templates for the formation of monometallic and bimetallic nanostructures

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A simple synthetic route to monometallic and bimetallic nanostructured materials is presented. Pyrolysis of the organometallic iron co-polyphosphazenes, [{[N = P(R 1) 2] 0.8[N = P(OC 6H 4CH 2CN[Fe]) 2] 0.15}{PF 6} 0.32] n (1) and [{[N = P(R 1) 2] 055[N = P(OC 6H 4CH 2CN[Fe]) 2] 0.2}{PF 6} 0.32] n (2) with R 1 = OC 12H 8 [Fe] = CpFe(dppe) + Cp = ?-C 5H 5, dppe = PPh 2(CH 2) 2PPh 2 in air affords nanoparticles of the iron pyrophosphate Fe 2Fe 5(P 2O 7) 4, while the pyrolysis of both copolymers in air and in the presence of TlPF 6 yield bimetallic Tl, Fe nanostructures. The polyphosphazene acts as a hybrid organic-inorganic template. By carbonization, the organic part of the polymer provides holes where the metallic centers grow while the inorganic P = N acts as precursor for the formation of phosphorus oxides, which form the metal pyrophosphates or the stabilizing matrix. Pyrolysis of organometallic polyphosphazene polymers containing two organometallic fragments is discussed as a new an