# Synthesis of Iron Germanide Nanoparticles via Thermal Decomposition of Organometallic Precursors

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Iron germanides ($FeGe_x$) provide several phases that display a unique variety of magnetic properties. The field of possibilities is further widened by the nanoscale effects, which modify the magnetic ordering as compared to the corresponding bulk alloys. Despite the attractiveness of nanoscale iron germanide structures, there exist only two synthetic approaches for their preparation: by using a chemical vapor transport process to give $Fe_{1.3}Ge$ at 650°C, [1] or by a solution phase synthesis via the reduction of iron and germanium organometallic precursors under strong conditions at T>260°C. [2] This example provides a proof-of-concept of the relevancy of solution-based strategies. However, the size, the shape or the phase purity are poorly controlled. The development of a novel route based of precursors specifically designed for this purpose can overcome these limitations.

We will present herein a novel approach for the preparation of iron-germanium nanoparticles, which relies on the design of organometallic precursors that display special features: i) a single source precursor already containing an iron germanium bond, ii) low coordinate atom to provide an easier access to elements at oxidation state of 0, and iii) labile substituents to facilitate their removal to produce naked atoms. The benefit of this strategy will be exemplified with a specifically designed precursor, a low valent germanium (II) complex (germylene), based on N-chelating amidinate ligand, which is coordinated to iron (0).

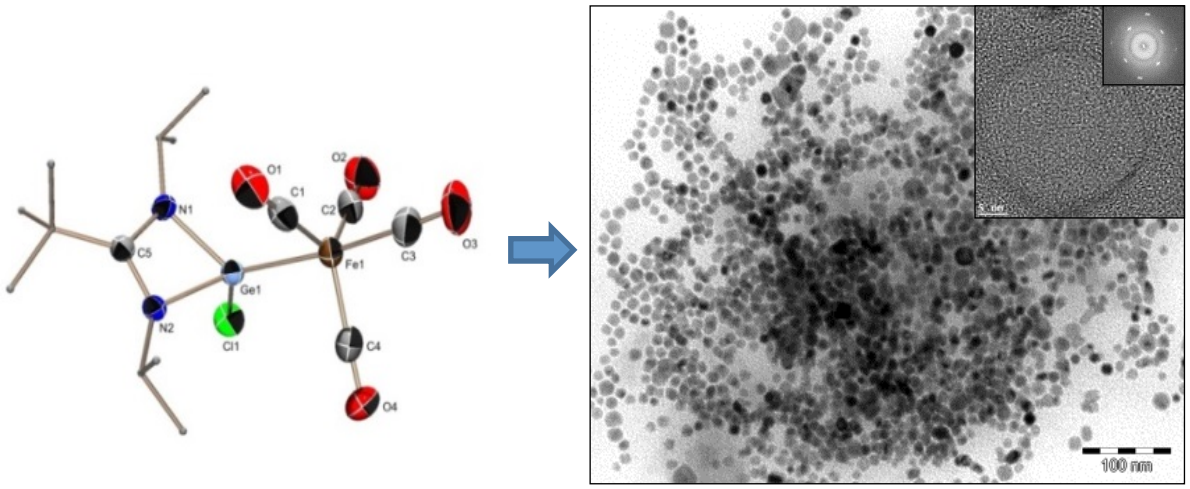


**Fig. 1** X-ray structure, TEM and HRTEM pictures of thermal decomposition of a Ge(II)/Fe(0) complex

We will, in particular, show i) how the design of organometallic precursors allows the access to FeGe-NP at the lower temperature ever reported using thermolytic approach ii) the influence of the substitution on germanium site on the control of the nanoparticles formation.

1) K. Chang, B. Kim et al., *J. Am. Chem. Soc.*, **2010,** 132, 17447.
2) R. Schaak et al., *Chem. Mater*, **2013**, *25*, 4396.