Green solvent for the synthesis of nanostructure materials

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Abstract: Size and shape of nanomaterials have great influence on its properties and applicability; therefore, many researchers have focused on rational control of phase, shape, size and dimensionality of nanomaterials [1]. On other hand "Benign by design approach" aimed to reduce chemical hazard and increase atom economy [2]. To produce/obtain benign procedure for synthesis, solvent used should be a green solvent for example deep eutectic solvent. Deep eutectic solvent (DES) is a green solvent generally composed of two or three cheap and safe components that are capable of self-association, often through hydrogen bond interactions, to form a eutectic mixture with a melting point lower than that of each individual component [3, 4]. DES's exhibit similar physico-chemical properties to the ionic liquids, while being environmentally friendlier. DESs have notable advantages such as their convenient synthesis (100 % atom economy), their very low price since most of DESs can be prepared from readily accessible chemicals and their low toxicity. Owing to these remarkable advantages, DESs are now of growing interest in many fields of research. DES not only serve the role of solvent but also act as a surfactant to stabilize and modify shape of the fabricated nanomaterials depending on its composition. In this direction, nanoparticles of CuO, Mn_2O_3, Pt and Pd were fabricated using DES. DES and obtained structure of nanoparticles were presented in tabular form in table 1: Table 1

Composition of DES	Particles	Structure obtained
ChCl-ethylene glycol	Mn_2O_3	Spherical, flower depending on water contained
chcl- gallic acid	CuO	spherical
ChCl-glycerol	Pt	Cubic
ChCl–citric acid	Pd	Star

Figure 1 present the schematic presentation for the synthesis of Mn_2O_3. The size and structure of the materials vary with the contained of the water.

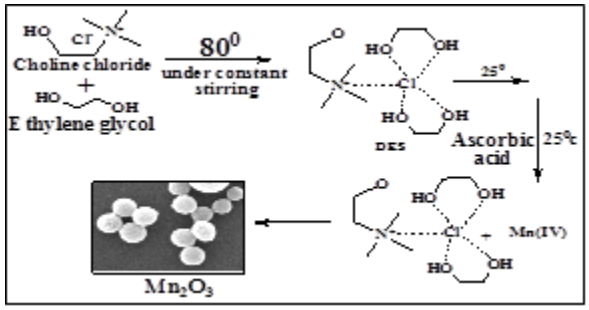

Fig 1 : Synthesis of Mn_2O_3 using DES.

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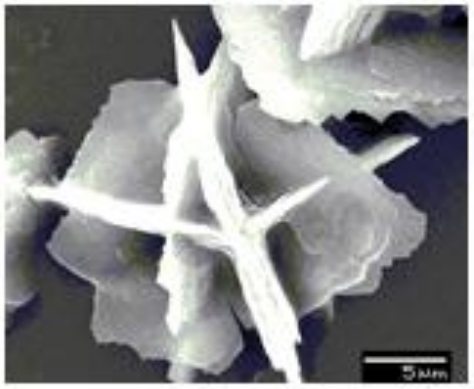
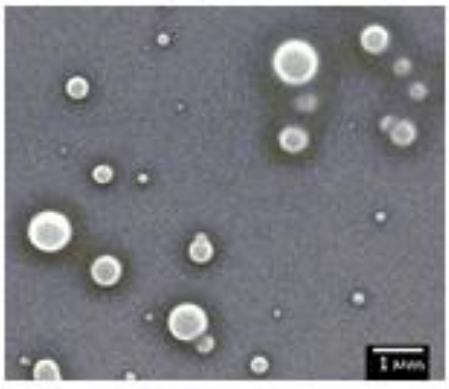

(A)

(B)

Fig 2: (a) Flower like structure and (b) Spherical Mn_2O_3

Water contain in DES ofChCl-ethylene glycol result drastic change in the structure of the synthesized materials. In absence of water, synthesized Mn_2O_3possessed a well bonded spherical structure (given in fig.1)while in presence of water it shows flower (500 µl) and spherical (1 ml) structure shown in fig 2(a) and (b) respectively. As such, by modifying the composition of this green solvent different structure of nanoscale materials can be fabricated.

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