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Synthesis & Characterisation of Polyvinylpyrrolidone (PVP) Capped Metal Oxide Nanoparticles for Ageing Studies

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The increased use of manufactured nanoparticles (MNPs) results in increased environmental release, hence concerns that exposure of humans and other organisms is inevitable. The potential environmental impact of MNPs is poorly understood and there is a need to better understand MNP fate and transformations.

PVP capped ceria nanoparticles were prepared according to the hydrothermal synthesis described by Merrifield et al. (2013). The synthesis protocol was successfully modified to produce PVP capped ZnO and PVP capped Cu_2O MNPs. This was done by substituting cerium nitrate with zinc nitrate and copper nitrate respectively. It is likely that the same mechanism of synthesis applies to all three oxides and suggests this is a very robust protocol with the potential to generate a wide range of comparable MNPs. A range of MNP sizes (c. 5, 7 and 20 nm) was obtained by varying the type and amount of PVP used.

Characterisation was carried out by means of DLS, UV/Vis, DCS and STEM. The DLS and DCS results show the different PVP capped MNPs to be very similar in size. UV/Vis allowed for the differentiation between the oxides. STEM allowed for core size analysis and the confirmation that nanoparticles are present in solution.

The samples obtained were stable when kept in the dark, as shown by size measurements. This was despite zeta values being very close or equal to zero. This is due to steric stabilisation resulting from the PVP capping shell.

Results to date suggest that the tested protocol can be successfully used to create PVP capped ceria, zinc oxide and copper oxide nanoparticles of reproducible sizes. The next stage of the research involves MNP ageing where the ageing procedures to be implemented include phosphate, UV and/or humidity exposure. The physical and chemical properties of the MNPs will be studied.

MERRIFIELD, R. C., WANG, Z. W., PALMER, R. E. & LEAD, J. R. 2013. Synthesis and Characterization of Polyvinylpyrrolidone Coated Cerium Oxide Nanoparticles. *Environmental Science & Technology,* 47**,** 12426-12433.