Frequency-dependent of AC susceptibility in chitosan oligosaccharide-Ag nanostructures

Nurul Akmal Che Lah[a], Muhammad Nasrulamin Mesran[a], Mohd Mawardi Saari[b]
[a] Innovative Manufacturing, Mechatronics and Sports (iMAMS Lab), Faculty of Manufacturing & Mechatronics Engineering Technology, Universiti Malaysia Pahang, 26600, Pekan, Pahang, Malaysia
[b] Faculty of Electrical & Electronic Engineering Technology, Universiti Malaysia Pahang, 26600, Pekan, Pahang, Malaysia

ABSTRACT
The observation on the non-linear magnetism of pure and polymer-capped silver (Ag) nanostructure in the random arrangement has been a puzzle since long ago. In the present study, the synthesised pure Ag nanostructures and chitosan oligosaccharide (COS)–Ag nanostructures with structure precision (0-D and 1-D nanostructures) and whose size range is known are observed to find out their origin of non-linear susceptibility magnetism using the custom-made AC susceptometer at 27 °C (300 K). Two established relations are considered (magnetisation, M and magnetic permeability, μ) based on the assessed effective susceptibility, χ. It is found that the transition field from diamagnetic to paramagnetic at which the total χ1,eff does the zero crossing is at dm ∼120 nm for pure Ag nanostructures. Whereas, for COS–Ag nanostructures with similar dm showed the paramagnetic behaviour. The results demonstrated that the transition of diamagnetism to paramagnetism based on effective χ1,eff and χ2,eff of reduced sizes and aggregated nanostructures for both pure Ag and COS capped Ag nanostructures are caused by the increasing of spin pairing and resulted in an increase of M_{eff} per atom as the particles get smaller. Interestingly, the COS macromolecules have a small M_{eff} themselves which helps in the transition of diamagnetic to paramagnetic Ag. The experiments can be the alternative way to monitor the paramagnetism of Ag nanostructures which could further provide insight for current development in designing the nanostructures with appropriate surface functional features that could be used as one of the promising SERS nanotags candidates in non-invasive imaging of cancer cells.

KEYWORDS
Silver nanostructures; Chitosan oligosaccharide; AC susceptibility; Diamagnetism; Paramagnetism

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