



Canadian Association
of Physicists

Association canadienne
des physiciens et physiciennes

Contribution ID: 557

Type: **Invited Speaker / Conférencier(ère) invité(e)**

(I) Large Kondo Effect in molecule-linked Au Nanoparticles Assemblies

Wednesday 9 June 2021 12:21 (5 minutes)

Interactions between localized, unpaired spins and delocalized electrons play a key role in a range of phenomena, including the Kondo effect, RKKY interactions and high T_c superconductivity. A number of recent studies have explored such interaction using hybrid systems combining 1) molecules with metal ions which contribute unpaired, localized spins and 2) deposited Au films which contribute delocalized electrons. Such studies have successfully observed a small Kondo effect.

Unexpectedly, a different set of studies have reported that using long (therefore, insulating) alkanethiol ($\text{CH}_3(\text{CH}_2)_n\text{SH}$) molecules as “surface coatings” for Au nanoparticles can generate magnetism in the nanoparticles. Neither bulk gold nor alkanethiols are magnetic by themselves, and it is believed that the thiols (-SH) generate holes in 5d orbitals of gold.

Using short (therefore, conducting) butanedithiol ($\text{HS}(\text{CH}_2)_4\text{SH}$) molecules as crosslinkers for Au nanoparticles, we have observed for the first time a Kondo effect in this molecule linker- Au nanoparticle system. The Kondo effect here is much larger relative to other temperature dependent phenomena –more than 10-fold larger than previously reported in studies using deposited Au films. These results afford testing Kondo models in a much stronger regime, and we find that published theory continues to hold. Importantly, we show that by changing the nanoarchitecture of the films, we can raise the Kondo temperature 10-fold, to $>250\text{K}$. These results point to molecule linker-nanoparticle assemblies as a versatile and potentially powerful means to generate materials exhibiting strong electron-electron interactions.

Author: DHIRANI, Al-Amin (Department of Chemistry, University of Toronto)

Co-authors: Dr TIE, Monique (Department of Chemistry, University of Toronto); Mr GRAVELSINS, Steven (Department of Chemistry, University of Toronto); Prof. NIEWCZAS, Marek (McMaster University)

Presenter: DHIRANI, Al-Amin (Department of Chemistry, University of Toronto)

Session Classification: W1-9 Superconductors and other Quantum Materials (DCMMP) / Supraconducteurs et autres matériaux quantiques (DPMCM)

Track Classification: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)