

Solid State Properties of Metallofullerenes

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Dielectric and magnetic properties are reported on metallofullerene La@C₈₂ solids. Due to the intramolecular charge transfer from the encapsulated metal to the carbon cage, metallofullerene La@C₈₂ have both magnetic and dielectric activity. In addition, due to the spherical shape of molecules, La@C₈₂ has a rotational degree of freedom in a similar manner to other empty fullerenes, which produces novel aspects in La@C₈₂ solids.

The dielectric constants ϵ of La@C₈₂ at room temperature is about 40, being roughly one order larger than that for C₆₀, indicating that the electric dipole of the metallofullerene molecule is responding to the external electric field. The temperature dependence of the dielectric constant is sensitive to the rotational transition of molecules, showing a peak behavior at 410K. The dielectric constant is reduced at low temperature, implying that the rotational motion of polar molecules are responsible for the dielectric activity [1].

Magnetic properties also revealed a unique aspect of La@C₈₂ solids. An electron spin resonance (ESR) experiment on single crystals of cubic La@C₈₂(CS₂)_x displayed a magnetic bistability behavior at temperature

below 130K depending on the cooling rate [2]. When cooled down very slowly, the ESR linewidth is small with a smaller magnetic susceptibility. When quenched from room temperature, the linewidth is large with a larger magnetic susceptibility. An independently carried out structure analysis [3] suggests that this magnetic bistability is related to the rotational ordering of molecules.

[1] C. J. Nuttall et al., Adv. Mater. in press.

[2] C. J. Nuttall et al., Phys. Rev. B62, 8592 (2000).

[3] T. Watanuki et al., Proc. IWEPNM99, AIP, New York 1999, p.124.