Patterns formed by C_{60} and magnetic nanoparticles via the coffee ring effect

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When a droplet of solution, in which molecules or particles are dispersed, is evaporated on a smooth surface, ring-shape structures composed of those molecules and particles, which are called coffee-rings, are formed [1].

In this study, we form secondary structures composed of C_{60} molecules [2] via the coffee ring effect and discuss some facile ways for creating novel patterns formed by C_{60} molecules. The outline of the experimental setup is shown in Figure 1.

First, we investigate the effect of the temperature gradient on a substrate on the patterns formed by C_{60} molecules via the coffee ring effect. 0.6 μmol/ml of C_{60} and 3.1 μmol/ml of sulphur are dissolved in benzene and the solution is introduced into circular cavities of 8, 10 and 12 mm diameter placed on a substrate. Half of the surface of the bottom of the cavities is heated so that a temperature gradient is established. The structures formed by C_{60} molecules after the evaporation of the solvent are observed and analysed by a scanning electron microscope (SEM). We then carry out another experiment to investigate the effect of local heating on the patterns formed by C_{60} molecules. We mix Fe_3O_4 particles of 20 nm diameter with the solution of C_{60} molecules and sulphur dissolved in benzene and an ac magnetic field is applied to the mixture. The structures formed by C_{60} molecules are observed by SEM.

We find that rings composed of C_{60} are formed on the substrate and that both the gap between the rings and the width of each ring become shorter at regions of higher temperature. We also find that rings composed of C_{60} and magnetic nanoparticles are formed and that both the gap and width decreases in the presence of the ac magnetic field. We explain the details of the secondary structures formed by C_{60} molecules at the poster session.

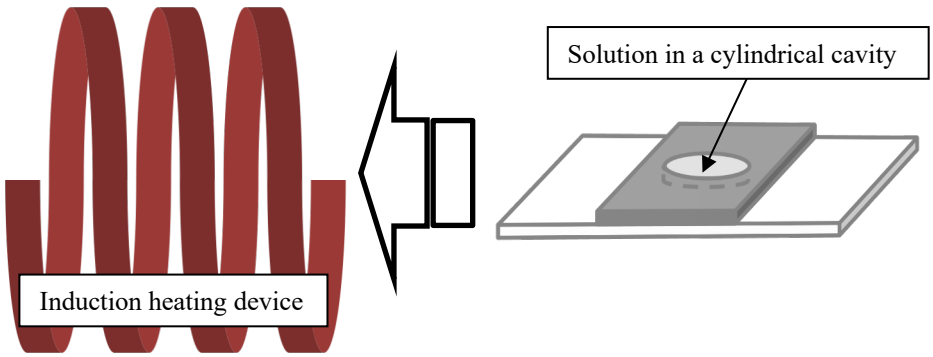

Figure 1. Outline of the experimental setup. Solution of C_{60} molecules/sulphur or C_{60}/sulphur/magnetic nanoparticles dispersed in benzene is introduced in a cylindrical cavity, which is placed on a grass substrate. The bottom of the test cell is heated or the test cell is subjected to an ac magnetic field.

References:

[1] R.D. Deegan, O. Bakajin, T.F. Dupont, G. Huber, S.R. Nagel, T.A. Witten, *Nature* **389**, 827–829 (1997).
[2] H.W. Kroto, A.W. Allaf, A.P. Balm, *Chem. Rev.* **91**, 1213–1235 (1991).