Formation of periodic patterns composed of fullerene (C_{60}) molecules via the coffee-ring effect.

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Patterns formed in colloidal dispersion; e.g. coffee powders in water, is of great importance from both scientific and technological points of view. It is well known that a ring-shaped structure consisting of colloidal particles is formed at the outer circumference of dispersion via the coffee-ring effect during the solvent's evaporation process. The coffee ring effect can be actively utilised for the formation of various patterns composed of colloidal particles. Stripe and periodic dots patterns consisting of colloidal particles were formed along the contact line of the dispersion on a substrate, dipping the substrate in a perpendicular direction, the formation mechanism of which was studied both theoretically and numerically [1]. Furthermore, ring-shaped structures were formed via the coffee-ring effect by not only colloidal particles but also C_{60} and sulphur molecules [2].

Our present study focuses on a variety of patterns formed by C_{60} and sulphur molecules via the coffee-ring effect; (1) C_{60} and sulphur dissolved in benzene were dropped into a cylindrical cavity on a substrate. After the evaporation of the solvent, a concentric circular pattern composed of fibres was formed. In addition, the shapes of these structures were successfully altered, changing the shapes of the cavities. (2) A glass substrate was dipped in C_{60}/sulphur solution in a perpendicular direction, then the solvent was aspirated at a constant speed by a syringe pump. Linear patterns were formed by fibres composed of C_{60} and sulphur on the substrate. We found that the width of patterns and the gap between neighbouring patterns can be changed depending on the solution's temperature, the concentration of C_{60} and sulphur, the cavity diameter and the aspiration rate of the solvent. The present methodologies may well be applied to the formation of patterns composed of different materials such as Fe nanoparticles and carbon nano materials, and can be utilised particularly in the field of biomedicine; e.g., trapping of target cells or encouragement of some biochemical reactions on micro chips.

References:

[1] Satoshi Watanabe and Minoru T. Miyahara, *Adv. Powder Technol* . **24** 897 (2013).
[2] Shunji Kurosu, Takahiro Fukuda, Toru Maekawa, *Adv. Nat. Sci: Nanosci. Nanotechnol.* **4** 025003 (2013).