Study of fullerene aggregates in pyridine/water solutions

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Introduction

The behavior of fullerenes in solutions is characterized by a sharp change of the solution color with a small change of the solvent composition. In particular, it was reported [1], that the mauve color of solutions C_{60}/pyridine/water with the H_2O concentration less than 50 molar % changes to yellow when the $8H_2O$ concentration approaches 50%. This effect is assumed [1] to be connected with a formation of specific aggregates in solutions. The dynamic light scattering study [1] has observed monodisperse spherical particles with the radius of about 30 nm. We applied synchrotron SAXS method to check the structure of fullerene in solution.

Experimental

C_{60} (Hoecht) was dissolved in pyridine with concentration 0.5 mg/ml. Then, this solution was diluted by water to 10% of pyridine concentration. Synchrotron X-ray measurements were done on a small-angle camera B15-A (Photon Factory, Tsukuba)

Results

Fig.1 shows the Guinier plot for two concentrations of C60. The estimated values of radius of gyration were in the range 15-17 nm which correspond to the balls with 20-22 nm radii. At the same time one can see the concave shape of scattering pattern in contrast to the convex shape for a ball (Fig.2). If there is an association of particles then the shape of scattering pattern becomes concave (Fig.2). Our electron microscopy studies show the spherical shape of associating particles. Thus, fullerene particles in solution are near spherical and inclined to an association. One can see some oscillations on scattering curve which may reflect the spheroid shape of particles but more precise measurements are necessary.

References

1) A.Mrzel, *et al*. *J. Phys. Chem.* **103:** 11256, 1999.

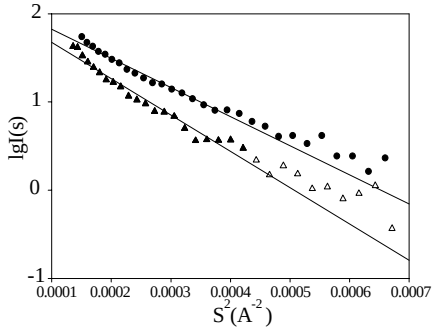

Fig.1 Lg(I) versus s^2 (Guinier plot) of C60 with 0.01mg/ml (circles) and 0.05mg/ml (triangles).

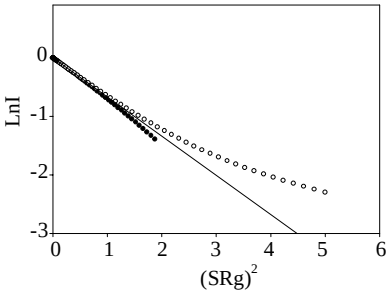

Fig.2 Ln(I) versus $(sRg)^2$ (Guinier plot) for a ball (⊙) and dimer of balls (o). Incline is 1/3.

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