**Fullerene-like $MoS_2$ synthesized at low temperature via a chemical solution route**

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Inorganic fullerenes and nanotubes of semiconductor transition metal dichalcogenides $MX_2$ (M = Mo, W; X = S, Se) are usually obtained at high temperature (950°C) by sulfurization or selenization of nanosized round or needle-like $MoO_{3-x}$ or $WO_{3-x}$ particles [1]. Fullerenes added in small amount to lubricating fluids improve their tribological properties. To obtain these fullerenes at low temperature is a challenge both for the understanding of their formation mechanism as well as for practical applications.

We have developed a new chemical method at low temperature (100-140 °C) which relies on the reactivity of $M_x(CO)_y$ (M being a transition metal, x: 1 or 3; y: 6 or 12) with chalcogen atoms dissolved in an organic solvent. This method allowed synthesis of $MX_2$ nanoparticles with controlled size and shape, in p-xylene. In this way, $MoSe_2$, $MoS_2$, $WS_2$ and $WSe_2$ nanoparticles (10-35 nm size), have been obtained [2-4].

To obtain $MoS_2$ fullerene-like particles, the synthesis of the nanoparticles has been performed in a mixture of a polar solvent (DMSO) and a non-polar solvent (nonanethiol), with the intention of making micelles inside which the reaction between $Mo(CO)_6$ and sulfur should be localized. After filtration, a powder constituted of amorphous and poorly-crystallized nanoparticles is obtained. After annealing the film at 550 °C in an evacuated quartz tube, fullerene-like $MoS_2$ particles exhibiting a nested polyhedron-shaped morphology consisting of few (5-9) closed atomic layers have been observed (Fig. 1) among a large number of $MoS_2$ crystallized nanoparticles. Additional work has been undertaken in order to understand the mechanism of formation of the fullerene-like $MoS_2$.

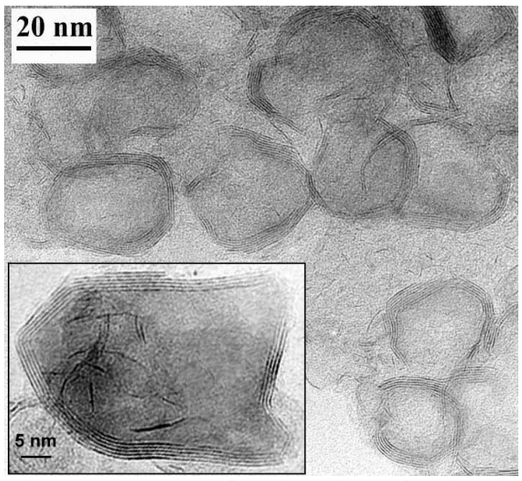


Fig. 1. HRTEM photo of fullerene-like $MoS_2$ obtained by chemical reaction in solution followed by annealing of the obtained powder at 550 °C

References

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