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Supercritical hydrothermal synthesis of amino-acid-displaying water-dispersible In2O3 nanocrystal and their optical properties

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Indium oxide (In_2O_3) nanoparticles were successfully synthesized via simple rapid hydrothermal method at 400 and 450°C under pressures of 25 and 30 MPa within 10 min. It was found that the highest temperature (450°C) and lowest pressure (25 MPa) condition was preferable to obtain pure cubic crystals of In2O3, because of the higher dehydration rate at 450°C and lower water concentration at low pressure (25 MPa). Moreover, we succeeded in the synthesis of hydrophilic amino-acid-modified In2O3 nanoparticles by the same method at 450°C and 25 MPa within 10 min. 5-Aminovaleric acid was used as the modifier. Changes in the surface properties of the nanoparticles by surface modification were observed by Fourier transform infrared spectroscopy, thermogravimetric analysis, zeta potential, and transmission electron microscopy (TEM), which demonstrated that the reagent chemically bound onto the surface of the In2O3 nanoparticles. The TEM images show that the morphology and size of the surface-modified nanoparticles were spherical with a diameter of 31 nm, respectively. The surface-modified nanoparticles were water dispersible; their isoelectric point shifted to a low pH range because of the nature of the carboxyl group contained in the structure. The synthesized unmodified and surface-modified In_2O_3 nanoparticles show a unique, wide-range blue–red light emission after excitation at 300 nm at room temperature. These results suggest that In_2O_3 nanoparticles could have significant potential for applications in optoelectronic devices.

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ABC/MWCNT composites mechanical behavour under dynamic load conditions

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In this paper, we aim to enhance the static and dynamic mechanical strength of Acrylonitrile-Butadiene-Styrene (ABS) terpolymer by constituting it with small compositions of Multi Walled Carbon Nanotubes (MWCNTs). Composites of ABS/MWCNT were fabricated with various MWCNT compositions (1, 3, 5, 7, 10 wt%) in ABS. These were then characterized to obtain quasi-static mechanical properties like hardness and elastic modulus using nano-indentation technique. It was observed that hardness and modulus for 10 wt% MWCNT composition in ABS/MWCNT composites were enhanced by 49% and 61% respectively in comparison to pure ABS. The visco-elastic nature of ABS/MWCNT composites was also investigated at nano scale using Dynamic Mechanical Analysis (DMA). Properties of ABS/MWCNT composites and pure ABS specimen were compared in dynamic mode for a loading frequency upto 200 Hz and it was observed that modulus of 10 wt% ABS/MWCNT composite was consistently higher by nearly 58% to 75% (upto 200 Hz) in comparison to that of pure ABS. The maximum strength for these composites under variable loading frequencies was achieved at lower loading frequencies, which indicated that properties of these composites enhanced up to loading frequencies of 100 Hz. Therefore, significant enhancement in mechanical strength of ABS was observed by composing minor compositions of MWCNTs (upto 10 wt%) without noticeable alteration in their weights, hence improving the prospects of ABS being used for engineering applications.

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