

## **Structural consequences of duplicitous chemical relation of cobalt and fullerene in mixture**

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Creation of the functional metal-C<sub>60</sub> hybrid materials is a fascinated way to exploit the remarkable electronic properties of fullerene. One of the attractive representatives of such hybrids is the cobalt-fullerene nanocomposite (NC) to be a promising candidate for application in ultra-high dense memory devices [1]. Recent discovery of giant magnetoresistance in Co-C<sub>60</sub> NC confirms great potential of this system in spintronics and nanoelectronics [2]. Nevertheless, the remarkable properties of the Co-C<sub>60</sub> composition could be really exploited if fabrication method can yield controllable nanostructures, and if principles of the NC structure formation are fully understood.

Here we present structural aspects of the Co-C<sub>60</sub> solid system fabricated by simultaneous deposition. Owing to set of the experiments the NC structure (as fcc-Co nanocrystals immersed into the C<sub>60</sub>-based matrix) of the co-deposited Co-C<sub>60</sub> mixture was recognized. Formation of the Co-C<sub>60</sub> NC reflects a dominant role of phase separation in the mixture film structure organization suggesting chemical inertness of the components. The composite structure is influenced by the internal stress rising during the mixture film growth. It is shown that competition of the phase separation and internal stress promotes formation of the Co-C<sub>60</sub> polymers in the NC matrix. This competition is influenced by temperature and by metal content that yields formation of different Co-C<sub>60</sub> polymers in the NC matrix. Detection of the Co-C<sub>60</sub> polymers in the NC material argues chemical bonding between metal and fullerene during the structure evolution. It was found that the Co-C<sub>60</sub> charge transfer under the mixture conditions can results in C<sub>60</sub> destroying that was observed even at room temperature. Increase of deposition temperature leads to increase of Co-C<sub>60</sub> bonding efficiency that leads to pronounced C<sub>60</sub> decomposition. On the contrary, thermal treatment of static Co-C<sub>60</sub> NC structure (post-deposition annealing) induces remarkable carbon structure organization in the NC matrix. The opportunity to control the Co-C<sub>60</sub> nanostructure by proper thermal treatment or through variation of metal content is stressed.

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