SYNTHESIS OF GRAPHITIC CARBON SUBNITRIDE FOR SPIN WAVEGUIDES

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GOAL
Magnetic heterostructures such as manganese perovskites, silicon-, graphene-based materials and hydrogenated g-C₃N₄ have spin-wave propagation driven by the spin-transfer torque mechanism [Consolo G., Curro C., Valenti G., Physics Letters A, 2015, V. 379, 1161-1168]. So they are perspective for the development of spin waveguides.
Our goal was to synthesize the new modification of g-C₃N₄ with layered structure for spin waveguides application.

EXPERIMENTAL
We synthesized melon, polycyclic molecular carbon subnitride, by the pyrolysis of NH₄SCN. In a typical synthesis process, a quartz tube, 32 mm in inner diameter and 170 mm in length, was used as the reaction chamber. Fine powder of ammonium thiocyanate (Sigma-Aldrich) was charged as the precursor. The synthesis was carried out at the temperatures from about 400 to 520 °C for 3 hours in atmosphere of He under the autogenous pressure due to the pyrolysis of the precursor. The quartz reactor was cooled to ambient temperature naturally. Then the powders were collected and washed with acetone, ethanol, and distilled water repeatedly to remove the residual reactants and the byproducts. Finally, samples with a yellowish-brown colour were obtained after the product was dried in a hot air flow (Fig. 2a).

RESULTS
X-ray diffraction (MiniFlex, Cu Kα radiation) pattern has a strong sharp peak at the position of 2θ = 27.7° (Fig. 1a). It corresponds to d-spacing to be 0.3314 nm. It reveals the regular stacking of graphene CNₓ monolayers along the (002) direction with the presence of turbostratic ordering of C and N atoms in the a-b basal planes. In the SEM image (JSM – 6490LV JEOL, 20.0 kV) of the prepared carbon nitride sample, as shown in Fig. 2b and 2c, large numbers of long, thin, columniform structures may be found. It can be seen that these cylindraceous columns are randomly oriented, with their diameters ranging from 0.05 to 0.25 μm and the lengths of them to be up to two micrometers. Several bundles composed of these thin columns are observable. However, lamellar sheets and bulky bumps with irregular shapes are also present (Fig. 2d).

CONCLUSIONS
The nanosized modification of g-C₃N₄ with layered structure was synthesized in gram scales. It could be recommended as model carrier for spin waveguides development.