# Raman investigation of graphene whiskers 

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Some organic (e.g. cellulose or keratin) materials containing the carbon atoms when subjected to high temperature sintering (over 2000 Co) in Ar atmosphere. After sintering these material evolve to multilayer graphene structures often in a form three dimensional cigarshaped object (Fig1). They were previously observed in graphite and called whiskers [1]. The Raman experiment on the whiskers was realized in back-scattering configuration with laser beam ( 532 nm ) parallel to the whiskers axis. The Raman spectrum close to the axis is presented in Fig.2. It shows extremely narrow and symmetric 2D Raman mode with FWHM as low as 14 cm -1 . The FWHM parameter is usually consider as a measure of graphene quality and low FWHM indicates high mobility. In whiskers the graphene stripes are arranged in a conical and helical structure where consecutive layers are twisted of about 27o. This is the most likely one of the reason why we observed single and symmetric 2D Raman mode. The correlation of 2D and G Raman modes is presented in Fig.3. The almost constant 2D mode energy with simultaneous spread in $G$ mode energy indicates both the ideal homogeneity of the whisker from the point of view of strain (tensile strain) and suggests the n - type of the carriers. This ideal strain homogeneity is the most likely responsible for the extremely low FWHM.

Figures




Figure 1: PingHeng Tan et all., PHYSICAL REVIEW B, 64, 214301 (2001)

