CAN SURFACE MEDIATED REACTIONS OF CO AND HYDROGEN ENHANCE COAGULATION IN THE INNERMOST REGIONS OF THE SOLAR NEBULA?.

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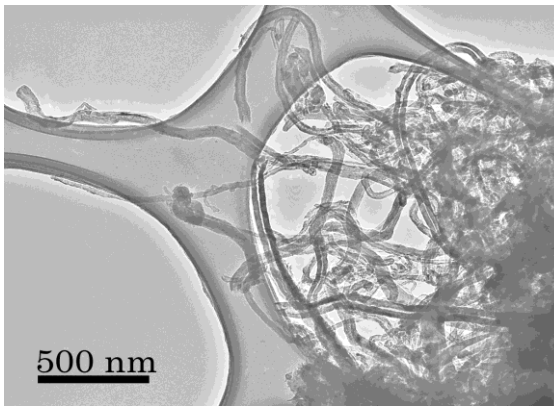
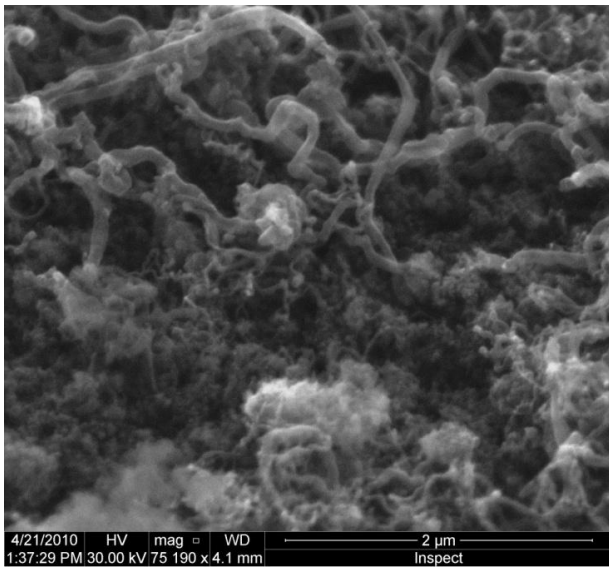
Introduction: Our experiments indicate that macroscopic carbon particles, many hundreds – or even thousands - of nanometers in length and quite irregular in shape, form on the surfaces of iron metal, amorphous iron silicate and graphite grains (see Figure 1). We have indirect evidence to suggest that such materials also form on the surfaces of magnetite, silica, bronzite and amorphous magnesium silicate grains as well. Specifically, the effective catalytic activity of magnetite, silica, bronzite and amorphous iron silicate grains for the destruction of CO and the production of CH_4 increases proportionally to the time that they are used as catalysts for such reactions. While some materials are more effective at converting CO into solid forms of carbon than are other catalysts, the fraction of solid carbon produced by such reactions always increases with temperature [1].





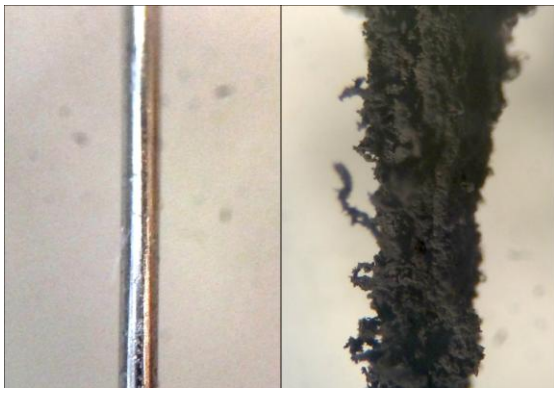


Figure 1. The image at the top (left) shows carbon nanotubes formed on graphite via reaction of CO + H2 at 873K. The image above shows similar structures formed on the surfaces of amorphous iron silicate smokes via reaction of CO + H2 at 873K. The split image at the bottom left is a section of iron wire (.009 inches in Diameter) shown at the same scale before (left) and after (right) it served as the catalyst for a single experimental run of CO + N_2 + H_2 => products at 873K.

In the outer solar system it has been suggested that collisional energy can be dissipated during the collision of ice particles in Saturn's rings by water ice frost on the grain surfaces [2,3], thus promoting the sticking efficiency of the colliding pair. We suggest that the potentially rapid growth of carbonaceous whiskers, filaments or nanotubes in regions where CAIs or chondrules are produced could promote planetesimal accretion by similarly dissipating the energy of grain-grain collisions and increasing the likelyhood that gently colliding macroscopic grains will stick. Carbon whiskers have been found associated with CAIs and chondrules [4] and additional searches are needed.

References: [1] Nuth, J. A., Johnson, N. M., Ferguson, F. T. and Carayon, A., 2016. Gas/Solid Carbon Branching Ratios in Surface Mediated Reactions and the Incorporation of Carbonaceous Material into Planetesimals *Meteoritics and Planetary Sciences*, in press. [2] Dilley, J. P. and Crawford, D. 1996. Mass dependence of energy loss in collisions of icy spheres: An experimental study. *Journal of Geophysical Research* 101:9267–9270. [3] Hatzes, A. P., Bridges, F. G. and Lin, D. N. C. 1988. Collisional properties of ice spheres at low impact velocities. *Monthly Notices of the Royal Astronomical Society* 231:1091–1115. [4] Fries, M, and Steele, A. 2008. Graphite whiskers in CV3 meteorites. *Science* 320:91-93.