Where and how we have met and learnt from G-surface

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To appreciate Alan Schoen's scientific impact to our community, we will focus on G-surface, among triply periodic minimal (TMP) G-, D- and P-surfaces, where three-dimensional (3d) silica-mesoporous -crystal (SMC) of MCM-48 with amorphous silica wall is formed.

Luzzati's group proposed structure of lipids; divalent polar groups were present on rods of finite length belonging to two interwoven infinite 3d-networks with *Ia*-3*d* space group symmetry and hydrocarbon chains constituted a continuous paraffin matrix. This corresponds to double gyroid [Nature 1967, **215**, 701], while a group of Mobil reported ordered mesoporous silica mesoporous crystals MCM-41 & MCM-48 (*Ia*-3*d*) from material aspects [Nature 1992, **359**, 710]. Discussions based on the quantum mechanics have been also reported indicating that the motion of electrons confined in curved geometry is different from that in 3D bulk crystals and relationship of electron energy bands among them [Ann. Phys. 1971, **63**, 586; PRA 1981, **23**, 1982; Prog. Theor. Phys. 1991,**106**, 235 & 1992, **88**, 229; PRB 2005, **72**, 085459].

We have developed a new electron crystallography (EC) *to obtain unique structure solutions of 3d-SMCs*, through an electrostatic potential distribution in real space, by Fourier analysis of a set of high-resolution transmission-electron-microscope (HR-TEM) images, which has clearly indicated 3d-SMCs are formed through co-operative self-assembly of inorganic species with organic surfactants in water [J. Electron Microsc. 1999, **48**, 795; Nature 2000, **408**, 449.] Furthermore, a self-consistent structural solution of 3d-SMCs has been obtained from EC as a constant mean curvature (CMC) surface by minimizing the Helfrich energy density of the boundary between inorganic and organic mesophase components [Angew. Chem. Int. Ed. 2010, **49**, 8867]. This makes possible to follow structural changes from as synthesized to calcined state systematically. In addition, we wrote a chapter, "Electron crystallography" for crystallographic understandings on G-surface, double and single gyroids and their mutual relationship together with basic electron microscopy.

At the Conference, following "Electron crystallography" we will discuss crystallography and electron microscopy on G-surface, single and double gyroids, *i.e.*, diffraction patterns (X-ray & electrons), EM images, most-probable and unique structure solutions using our accumulated experimental data.

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