A Report of Participation in Chemistry at the Frontiers of Biology and Physics

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This report describes my outcome by the participation in Chemistry at the Frontiers of Biology and Physics held at Université de Strasbourg, France from 30 June to 4 July 2010. All scientific programs were performed very comfortable conference hall in Institut de Science et d'Ingénierie Supramoléculaires (ISIS, Figure 1). Both universities participants presented stimulating research accomplishments, and there are also about 20 posters in front of conference hall. In such environment, my talk was scheduled on 2 July as one of the junior speakers. For me, this conference was a great opportunity to advertise outcome of our research. The title of my talk was "2D Crystal Engineering: a Four-Component Architecture at a Liquid/Solid Interface" in which I addressed construction of the first four-components molecular networks by using self-assembly at the liquid/solid interface. It was my great pleasure to present surface *Self-Assembly* topic at ISIS.

Figure 1. Photo of ISIS.

The aim of my presented topic was designing and controlling multicomponent heteromeric architectures on a surface by fine tuning of various interactions between molecules and those with a substrate. Indeed, three-component two-dimensional (2D) crystals formed by self-assembly both at the liquid-solid interface and under vacuum conditions are still rare, and to the best of my knowledge, no four-component crystalline architectures have been realized so far. Our achievement is the successful self-assembly of a four-component 2D crystal at the liquid/solid interface, formed upon simply mixing the four molecular components.

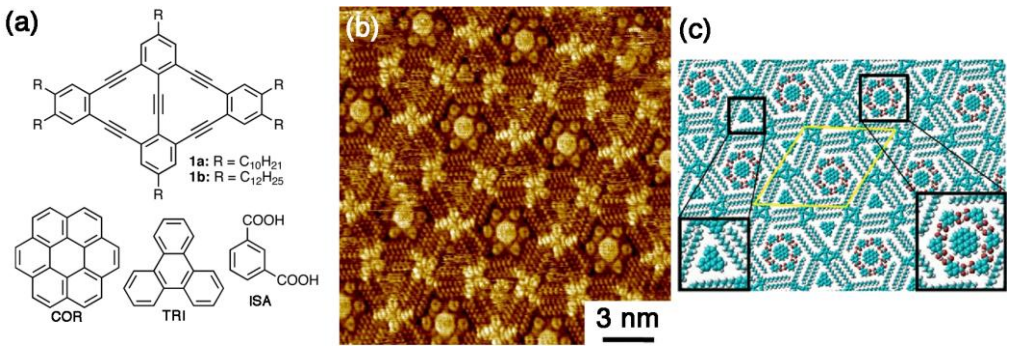

Figure 2. (a) Chemical structures of **1**, **COR**, **ISA**, and **TRI**. (b) An STM image of the four-component network. (c) The network model.

Our strategy to form such a multicomponent network is based on the structural properties of nanoporous networks, and their ability to host guest species. A Kagomé type network was fabricated previously with a rhombic-shaped fused dehydrobenzo[12]annulene derivative **1a** with decyl chains on a graphite surface (Figure 2a). The Kagomé network is characterized by two types of pores, which differ in size and symmetry.

From an engineering or structural point of view, our approach to form a 4-component 2D crystalline network is straightforward: a heterocluster of coronene (**COR**) surrounded by six hydrogen-bonded isophthalic acid (**ISA**) molecules is predicted to fit the hexagonal void of the Kagomé network of **1b**. This surface-confined heterocluster (**COR_1-ISA_6**) with a diameter of 2.5 nm is a stable entity. Molecular modeling foresees triangular guests such as triphenylene (**TRI**) to reside in the smaller triangular pores because of size and shape complementarity. After simply applying a drop of a 1-octanoic acid solution containing **1b**, **ISA**, **COR**, and **TRI** on the basal plane of graphite, a four-component molecular network was realized. Figures 2b and 2c show an STM image and model of the four-component architecture on the surface. All alkyl chains of **1b** are adsorbed and interact with those of adjacent molecules via alkyl chain interdigitation, forming the Kagomé structure. Each hexagonal void is filled with a **COR_1-ISA_6** cluster, and the triangular voids are filled by **TRI**. A key for the success is use of size matching between the pores and the guest molecule or the clusters. The presented 4-component 2D crystallization is a cooperative process involving the action of all components at the same time, and not a sequential process.

The audiences seemed to be surprised by the high quality STM image of final four-component network. In the discussion time, there were a lot of questions and suggestions. One question was about the concentration of four components in solution which was not mention in detail in my talk. The questioner was surprised the fact that we had been investigated about 30 different combinations to optimize the mixing ratio. One suggestion was about guest switching at the pore by adding different components though I thought it might be difficult because of high size and shape complementarity between the pore and guest molecules in present system. Obviously, the presentation and discussion not only stimulated my English ability but also confirmed my confidence about our experimental results.

The Osaka University participants were very welcomed during the stay period. We were invited to dinner everyday and excursion to see nice city of Strasbourg (Figure 3). We enjoyed very much to discuss about scientific issue as well as different cultures between both countries. I realize these intercommunications strengthen the friendship between the Osaka University and Strasbourg University. I would like to acknowledge organizers in Strasbourg University especially for Prof. Pierre Braunstein and Dr. Jean Weiss. Finally, I would appreciate very much GCOE program which provided me with this great opportunity.

Figure 3. Photo of the city of Strasbourg.