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Webinar #10

Prof. Jun Onoe

Department of Energy Science and Engineering, Nagoya University, Nagoya, Japan

Title: **Behavior of Electrons Propagating on 1D Periodic Concave-Convex Curved Surface : First Observation of Physical Properties Predicted by Quantum Mechanics of Submanifold**

28th June 2022, 11.00 am– 12.30 pm IST

Registration link: https://tinyurl.com/4yc7kku5

Biography

Prof. Jun Onoe graduated from Department of Chemistry at Osaka University (1987), and got Ph. D from Department of Physics at Kyoto University (1997). After he was a senior researcher at RIKEN (The Institute of Physical and Chemical Research), he joined the faculty member at Tokyo Institute of Technology as an associate professor (2002). Finally, he has been a full professor at Nagoya University since 2014. While being the present position, he was concurrently a Senior Fellow for Science and Technology Policy, Council for Science, Technology, and Innovation (CSTI), Cabinet Office, Government of Japan (2016–2017), and a Presidential Advisor/Head of Innovation Strategy Office (2018–2019). He has been a visiting professor at University of Strasbourg (France) since 2015. He won the 28th Incentive Award from The Atomic Energy Society of Japan and the 2nd Incentive Award from The DV-Xa Society in 1996, the Research Paper Award from Teshima Industrial Education Fund in 2006, the 7th Research Academic Award from The DV-Xa Society in 2009, and the Research Paper Award (Category A) from the Liquid Crystal Society of Japan in 2020. He has 140 publications with h-index of 25. He is an editorial board member of Frontiers in Nanotechnology. The current topics of his concern are 1) an interdisciplinary between modern geometry and materials science (quantum mechanics of submanifold), 2) Energy-harvesting using molecular materials (solar cells and thermoelectric devices), and 3) Specific nano-space materials applied to the disposal of nuclear wastes and the recycling of precious metals, by using *in situ* UHV cryo FT-IR spectroscopy, *in situ* UHV cryo four-probe measurement system, i*n situ* UHV STM/STS system, in combination with first-principles calculations based on density functional theory.

Abstract

Electron-beam-irradiation (3–7 keV) of a C_{60} film results in formation of a 1D C_{60} polymer film with a concavo-convex periodic curved structure *via* the generalized Stone-Wales transformation, which exhibits physical properties arising from 1D metal. The behavior of the electron on the curved surface is given by the Hamilton operator of the following equation.

$$\hat{H} = -\frac{\hbar^2}{2m^*}\left[\frac{1}{\sqrt{g}}\sum_{i,j=1}^{2}\frac{\partial}{\partial q^i}\left(\sqrt{g}\,g^{ij}\frac{\partial}{\partial q^j}\right) + (h^2 - k)\right]$$

Here, g = det $[g_{ij}]$ represents the metric tensor. The first term is an operator of the kinetic energy of electrons, and the second term consisting of the mean curvature h and the Gaussian curvature k appears like a scalar potential (the second term does not appear in the 1D plane surface). So far, it has been a mystery whether or not this curvature term affects the behavior of electrons since 1950s. We theoretically predict the effect of the geometric curvature term on the electronic behavior of the above 1D C_{60} polymer and then experimentally demonstrate it. In my talk, I will present the fundamental aspects and recent applications of the 1D C_{60} polymer.

Panelist

Prof. Qian Wang
School of Materials Science and Engineering, CAPT,
Peking University, Beijing, China

Zoom meeting details will be shared with the registered participants

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