

Okazaki Conference

(a) The 82nd Okazaki Conference Recent Advances and Perspectives of Interfacial Materials and Molecular Sciences Lead by Next-Generation Laser Techniques and Computational Science

(July 28–31, 2025)

Organizers: T. Sugimoto (*IMS*), A. Morita (*Tohoku Univ.*)

Invited Overseas Speaker: Yuen-Ron Shen (*Univ. of California Berkeley, USA*), Hai-Lung Dai (*Temple Univ., USA*), Eric Borguet (*Temple Univ., USA*), Elsa Yan (*Yale Univ., USA*), Chuanshan Tian (*Fudan Univ., China*), Martin Thämer (*Fritz-Haber-Inst., Germany*), Hongfei Wang (*Westlake Univ., China*), Sean Roberts (*Univ. of Texas at Austin, USA*), Ali Hassanali (*International Cent. for Theoretical Physics, Italy*), Franz Geiger (*Northwestern Univ., USA*), Juli Gibbs (*Univ. of Alberta, Canada*), Dennis Hore (*Univ. of Victoria, Canada*), Zefeng Ren (*Dalian Inst., China*), Craig Schwartz (*Univ. of Nevada, USA*), Eric Tyrode (*KTH Royal Inst., Sweden*), Doseok Kim (*Sogang Univ., Korea*)

Interfacial molecular science plays a central role in elucidating the origins of critical material functions such as heterogeneous catalysis, molecular devices, batteries, and sensors, and has long been one of the major frontiers of molecular science. In recent years, remarkable advances supported by state-of-the-art laser techniques and computational science have positioned Japan as an internationally recognized contributor to this field. To further promote its development and global visibility, we organized this international conference.

Nonlinear optical spectroscopy with intrinsic interfacial selectivity, particularly vibrational sum-frequency generation (SFG), has proven to be a uniquely powerful approach for studying soft surfaces and buried interfaces, extending the

scope of conventional surface science. Japan has historically provided fundamental international leadership in this field, through both the theoretical formulation and computational realization of SFG, and the development of broadband phase-sensitive detection methods. More recently, IMS achieved the world's first success in tip-enhanced near-field SFG nanospectroscopy, breaking the diffraction limit by several orders of magnitude. Building on this foundation, new approaches are rapidly emerging, including ultrabroadband IR–terahertz techniques and theoretical models capable of reproducing the full complexity of interfacial SFG spectra.

The conference program reflected the breadth of this expanding field. Presentations covered the development of new spectroscopic methods such as near-field tip-enhanced SFG, synchrotron-radiation-based second harmonic generation and theoretical advances that capture both interfacial and bulk contributions. Additional highlights included the development of SFG scattering spectroscopy and its application to nanoparticle surfaces, studies of solid–liquid mineral interfaces in environmental chemistry, selective probing of proteins at biological interfaces, solvent structures at electrochemical interfaces, and interfacial properties of organic molecular devices. By uniting these diverse topics under the common framework of interfacial spectroscopy, the meeting successfully created an international platform for scientific exchange and discussion. This outcome is expected to have a significant impact in shaping a shared vision for the future of interfacial molecular science.

