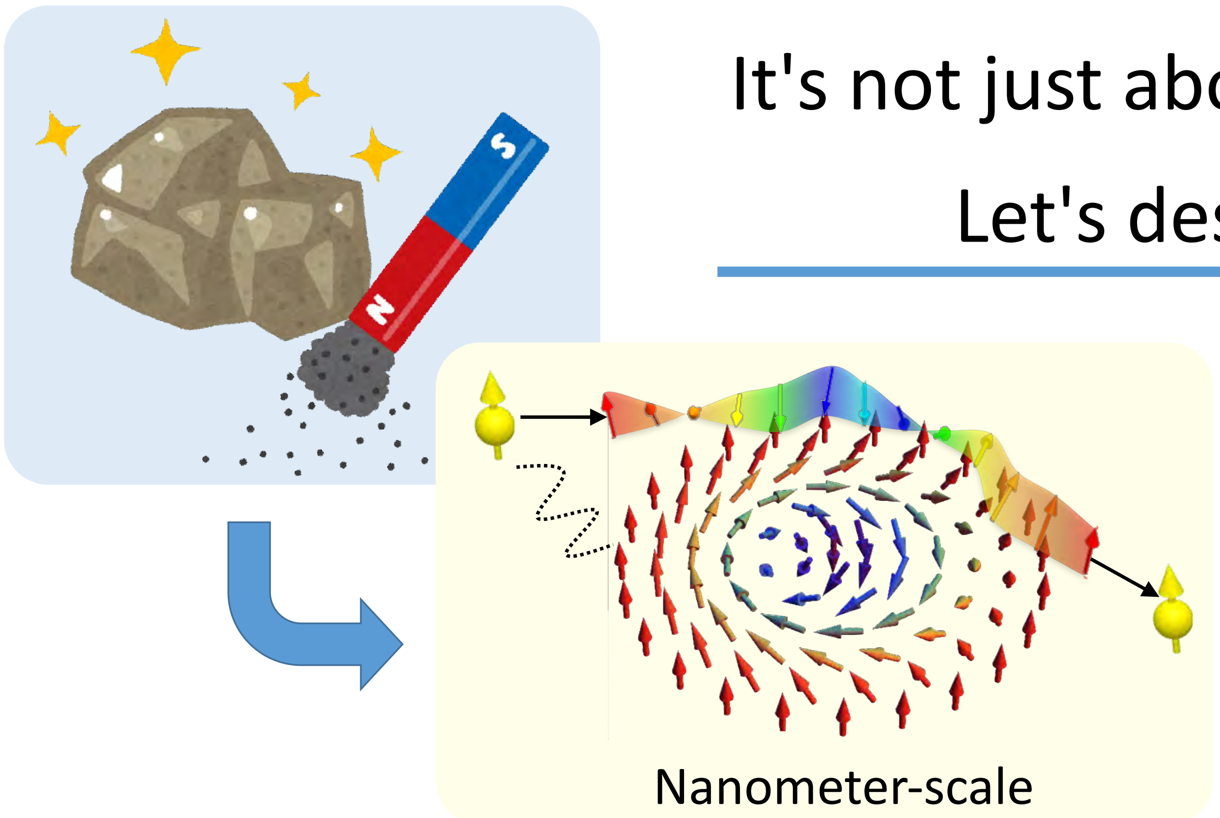
KANAZAWA LAB.

Quantum Materials interface

Department of Fundamental Engineering

Quantum Materials Interface Science
Department of Applied Physics, Graduate School of Engineering https://sites.google.com/view/kanazawa-lab



It's not just about "electrically conductive" or "sticking to things".

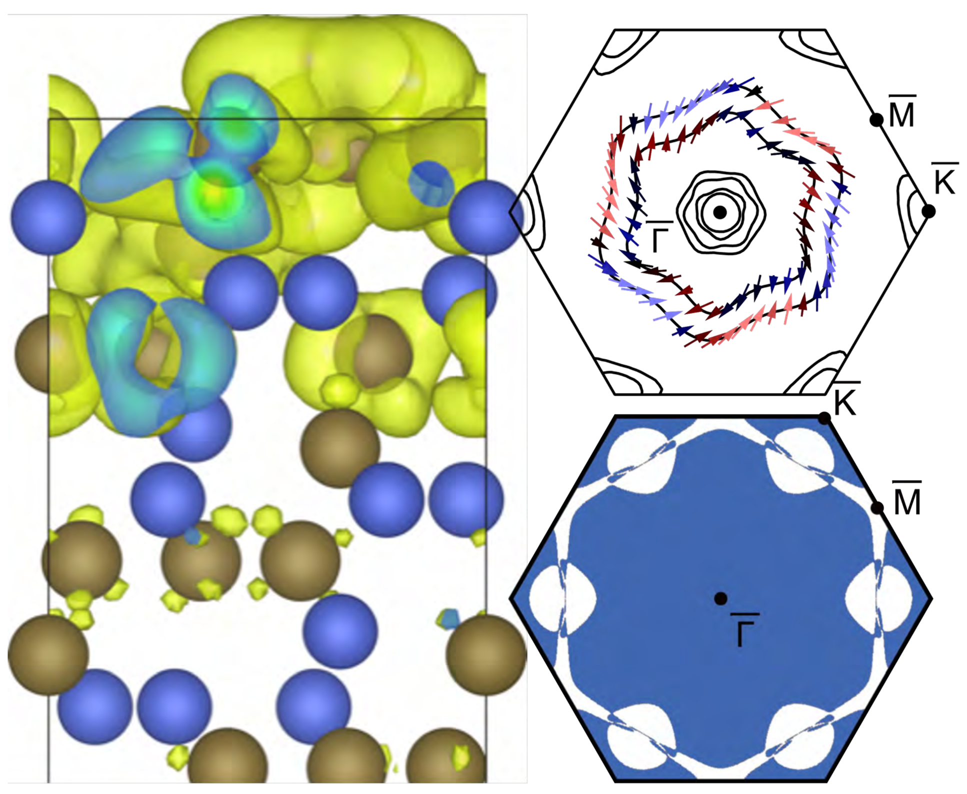
Let's design materials and functions in the QUANTUM world!

Why do metals conduct electricity and why do magnets stick to iron? Since the birth of quantum mechanics, we are able to understand their origins at the microscopic level. Furthermore, the modern technology has made it possible to "see" physical phenomena and chemical reactions on the atomic scale.

In fact, metals do not just conduct electricity, and magnets do not just stick to iron, but something more complex can happen. E.g., nanometer-scale spin textures can spontaneously emerge, and electrons interact with these nanostructures to exhibit novel conduction phenomena.

In our laboratory, we aim to deeply understand chemical bonding in materials using mathematical concept “topology”. And we will explore new quantum phases (especially at surfaces and interfaces) and quantum functionality (especially for GX and AI technologies).

New surface states based on topology of electric polarization



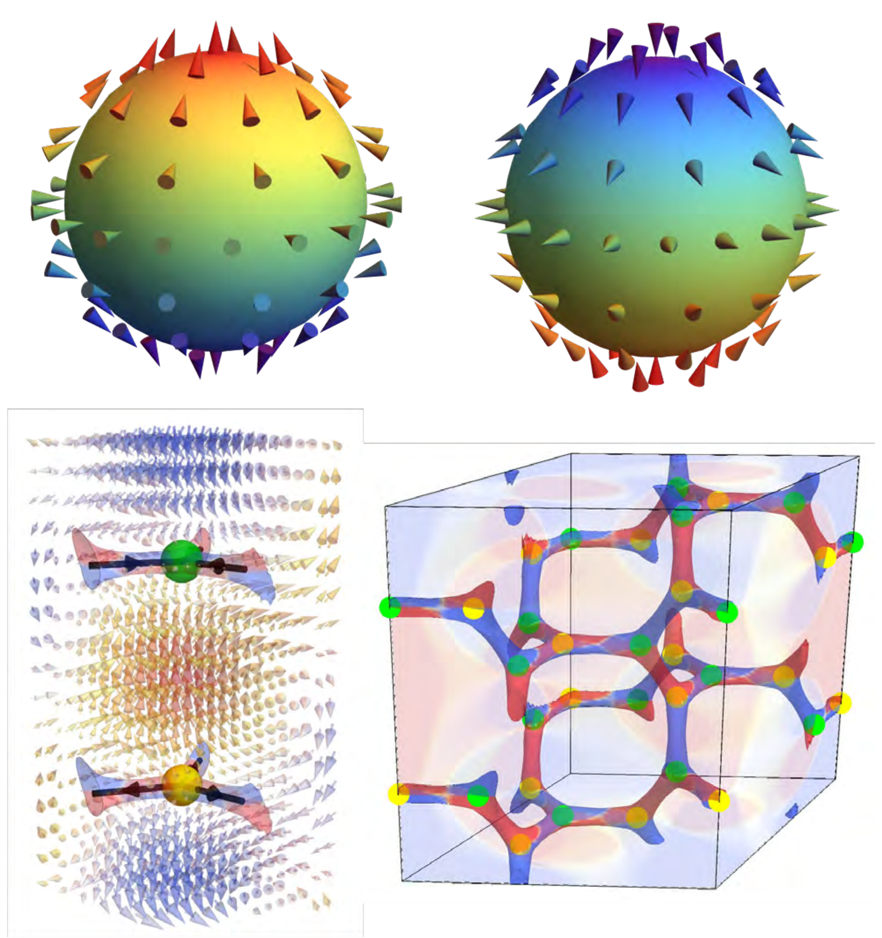
Zak phase

$$\theta(\boldsymbol{k}_{\parallel}) = -i\sum_{n}^{\text{occ.}}\int_{0}^{G}\left\langle u_n(\boldsymbol{k})\middle|\frac{\partial}{\partial k_{\perp}}\middle|u_n(\boldsymbol{k})\right\rangle dk_{\perp}$$

Synthesis of environmentally friendly, high-performance topological materials.

Designing topological quantum functions that can be controlled by electricity, heat, sound waves and so on.

Self-assembly of magnetic nanoparticles and nonlinear dynamics

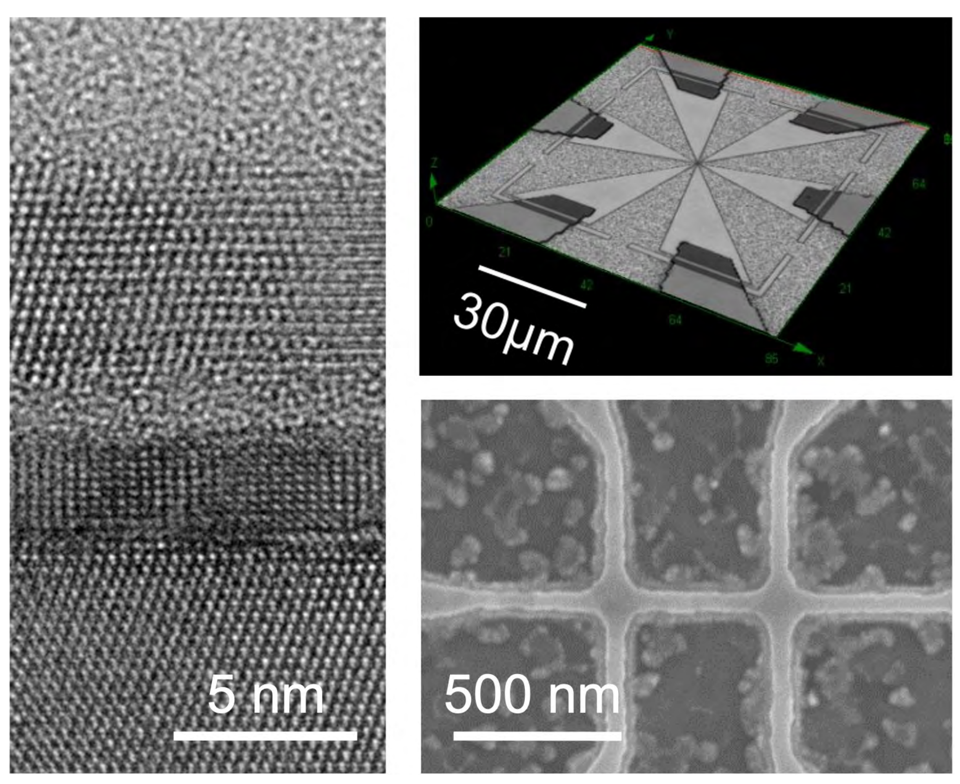


New hardware for neuromorphic computing technology.

Giant nonlinear and nonequilibrium quantum transport properties.

Utilizing Iontronics.

Strong fluctuations in low-dimensional nanostructures



Micro-energy harvesting technology via nanodots fabrication & nano-device processing technology.

Enhanced thermoelectric properties and rectification of quantum fluctuations.