TYPE Editorial
PUBLISHED 25 June 2024
DOI 10.3389/fmats.2024.1430228

OPEN ACCESS

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RECEIVED 09 May 2024
ACCEPTED 06 June 2024
PUBLISHED 25 June 2024

CITATION
Wang X and Harris VG (2024), Editorial: Innovators in quantum materials.
Front. Mater. 11:1430228.
doi: 10.3389/fmats.2024.1430228

Editorial: Innovators in quantum materials

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KEYWORDS

quantum materials, topological phonons, heterojunction modeling, first-principle calculations, 2D magnetic materials

Editorial on the Research Topic
Innovators in quantum materials

The concept of "Quantum Materials" has gained prominence in various scientific and technical disciplines where their quantum phenomena (e.g., entanglement, superposition, tunneling, and spin-orbit interactions) advance emerging fields of science and technologies such as quantum computing (Nielsen and Chuang, 2000), teleportation (Bennett et al., 1993), encryption (Gisin et al., 2002; Pirandola et al., 2020), sensing (Degen et al., 2017), and new modalities of electronics including spin-orbitronics (Manchon et al., 2015), caloritronics (Bauer et al., 2012), magnonics (Kruglyak et al., 2010), twistronics (Hennighausen and Kar, 2021), and valleytronics (Schaibley et al., 2016), that provide effective driving forces to new global commercial markets.

Scientists who actively investigate quantum materials engage in a wide range of challenges that lie at the vanguard of physics, materials science, and engineering. None of these advancements would be possible without the talented community of researchers working across the world that include Nobel Prize winners to rising stars to entry level students. This Research Topic is intended to highlight those scientists who are at the forefront of this important field.

The silicon dioxide-silicon amorphous interface (a-SiO_2/Si) is a critical component of silicon devices. Liu et al. report first-principle calculations that examine the impact of stress on the depassivation reaction of P_b defects at the a-SiO_2/Si (111) interface and P_{b1} defects at the a-SiO_2/Si (100) interface. Their investigation is important to engineering practices as it helps in advancing the understanding of performance degeneration in real devices. With the help of first-principle calculations, Zhang et al. provide much-needed theoretical underpinnings describing the interaction of H_2O and interface defects in a-SiO_2/Si(100).

The realm of quantum materials has broadened to encompass two-dimensional (2D) material systems and associated heterostructures whose interactions and fundamental reactivities are governed by van der Waals forces. Furthermore, an increasing number of scientists are directing their attention to 2D magnetic materials due to their potential uses in the fields of information processing and storage. Liu et al. built a $CrGeTe_3$/NiO heterojunction model and studied the electrical and magnetic properties of the $CrGeTe_3$/NiO interface with the help of first-principle calculations.

Topological phononics can be developed by incorporating fundamental theorems and concepts of topology into the study of phonons, similar to what has been demonstrated in the field of topological electronics. With the help of first-principle calculations, Li proposed that the phononic nodal points and nodal lines appear in the phonon dispersion curves of Boron Phosphide with a zinc-blende structure.

We hope this Research Topic will attract a large cross-section of interested readers. Additionally, every author, reviewer, and editor who contributed to this Research Topic is acknowledged.

Author contributions

XW: Writing–original draft, Writing–review and editing. VH: Writing–original draft, Writing–review and editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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