北京大学量子材料科学中心

International Center for Quantum Materials, PKU

量子物质名家讲堂

Quantum Matter Distinguished Lecture Series

ALCHEMY OF THE XXI CENTURY:
DIGITAL SYNTHESIS OF QUANTUM MATERIALS

Ivan Božović

Shanghai Advanced Research in Physical Science (SHARPS)

Time: 11:00 am, Nov.5, 2025 (Wednesday)

时间：2025年11月5日（周三）上午11:00

Venue: Room w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

Atomic-layer-by-layer molecular beam epitaxy (ALL-MBE) is a new technique developed in the last few decades to synthesize functional quantum materials, including high-temperature superconductors (HTS), other complex oxides, and two-dimensional materials such as graphene and borophene. It also enables one to synthesize novel metastable materials that cannot be synthesized by standard methods. Several examples will be presented of ALL-MBE alchemy — the creation of artificial materials with novel and unique electronic properties. The ability to engineer the materials at a single-atomic monolayer level has also enabled important discoveries of novel physical phenomena and effects in HTS cuprates and beyond [1].

This talk is aimed at a broad audience, so the emphasis will be on painting the big picture and pointing at the goals we hope to reach eventually. One of these is to discover a new material that superconducts at room temperature and ambient pressure. Another is to build an HTS-based, desktop-size neuromorphic computer, approaching the human brain's neuron count (10-100 B) and power consumption (10 W), as the ultimate platform for Artificial Intelligence of the future.

[1] *Nature* **572**, 493 (2019); **547**, 432 (2017); **536**, 309 (2016); **472**, 458 (2011); **455**, 782 (2008); **422**, 873 (2003); **398**, 221 (1999). *Science* **361**, 479 (2018); **326**, 699 (2009); **316**, 425 (2007); **297**, 581 (2002); **282**, 2067 (1998). *Nature Physics* **16**, 712 (2020); **12**, 22 (2016); **10**, 892 (2014); **7**, 298 (2011); **14**, 377 (2022). *Nature Materials* **21**, 11 (2022); **12**, 1019 (2013); **12**, 877 (2013); **12**, 387 (2013); **12**, 47 (2013); **11**, 850 (2012). *Nature Nanotechnology* **18**, 343 (2023); **14**, 44 (2019); **9**, 443 (2014); **9**, 5210 (2018); **2**, 272 (2011); **5**, 516 (2010). *Nature Chemistry* **14**, 377 (2022). *Nature Communications* **9**, 5210 (2018); **2**, 272 (2011); **5**, 516 (2010).

About the speaker

Ivan Bozovic received his Ph.D. in Solid State Physics from Belgrade University, Yugoslavia, where he was later elected a professor and the Physics Department Head. After moving to the USA in 1985, he worked at Stanford University, the Varian Research Center in Palo Alto, California, and Oxxel, Bremen, Germany. Since 2003 he was the MBE Group Leader at Brookhaven National Laboratory, and since 2014 an Adjunct Professor at Yale University, and in November 2024 he joined Shanghai Advanced Research in Physical Science (SHARPS).

He is a Member of the European Academy of Sciences, a Foreign Member of the Serbian Academy of Science and Arts, Professor Honoris Causa of the University of Montenegro, a Fellow of the American Physical Society (APS), and a Fellow of the International Society for Optics and Photonics (SPIE).

He received the APS McGroddy Prize for Materials Physics, the Bernd Matthias Prize for Superconducting Materials, the SPIE Technology Award, M. Jaric Prize, BNL Science and Technology Prize, etc. He was elected as Max Planck Lecturer, Van der Waals Lecturer, and (twice) Gordon and Betty Moore Foundation Principal Investigator.

Ivan's research interests include fundamental physics of condensed states of matter, novel electronic phenomena including unconventional superconductivity, innovative methods of thin film synthesis and characterization, and nano-scale physics. He published 11 research monographs and over 300 research papers, including over 30 in Science and Nature journals.