TECHNOLOGY OFFER

In-Situ Magnetic Resonance Spectroscopy in a Transmission Electron Microscope

Researchers at TU Wien have developed a groundbreaking technology integrating magnetic resonance methods (NMR, ESR, FMR) directly into a Transmission Electron Microscope (TEM). At the core of this innovation is a new designed sample holder, equipped with microwave excitation and detection elements. This holder leverages the strong magnetic field of the TEM pole piece to enable spin polarization, facilitating simultaneous electron beam imaging and magnetic resonance spectroscopy. The sample holder's unique design bridges the gap between high-resolution TEM imaging and the spectral precision of magnetic resonance, creating new possibilities for analyzing the magnetic and quantum properties of miniaturized samples, opening new avenues in material science, nanotechnology, and molecular biology.

BACKGROUND

Transmission Electron Microscopy is a powerful, but invasive imaging technique widely used to visualize ultra-small structures down to atomic scales, with extensive applications in medical research, life sciences, materials science, and nanotechnology. Non-invasive magnetic resonance methods such as ESR, NMR, and FMR offer high spectral resolution for studying electronic structure, molecular dynamics and magnetic and quantum properties of materials. However, these techniques are traditionally limited by low spatial resolution. Integrating magnetic resonance methods within a TEM overcomes certain limitations and enhances both TEM imaging and magnetic resonance spectroscopic insights.

TECHNOLOGY

TU Wien's novel technology integrates a sample holder with microwave excitation and detection elements within a TEM. This setup uses the strong magnetic field of the pole piece of the TEM for spin polarisation, allowing dual-function examination under an electron beam and magnetic resonance spectroscopy.

BENEFITS

- High spectral resolution
- Microwave Excitation: Facilitates precise spectral characterization.
- Dual-Functionality: Combines TEM imaging with magnetic resonance analysis for deeper material insights.
- Compatibility: Works seamlessly with standard TEMs and off-the-shelf microwave electronics
- Enhanced Research Potential: Ideal for applications in nano - magnetism, material science, and molecular biology

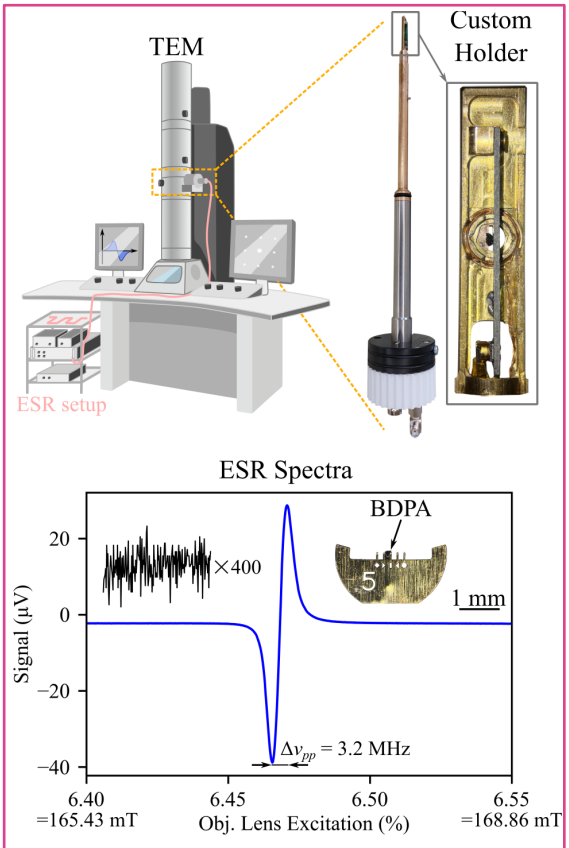

FIGURE (above): Electron spin resonance spectroscopy on a custom build sample holder in a transmission electron microscope ©TU Wien

Electron Spin Resonance Spectroscopy in a Transmission Electron Microscope, Antonín Jaroš et al, arXiv:2408.16492 **https://arxiv.org/abs/2401.06496**

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APPLICATION AREAS:
- Molecular analysis
- Material science (e.g., nanostructures and magnetic properties)
- Molecular biology and quantum systems research
- Energy storage and battery technology

DEVELOPMENT STATUS:
- TRL 3

KEYWORDS:
- Transmission Electron Microscopy (TEM)
- In-situ Spectroscopy ESR/NMR/FMR
- Quantum systems
- Quantum physics
- Microwave Spectroscopy
- Ultra-fast Electron Microscopy
- Quantum Electron Optics

IPR:
- PCT filed

OPTIONS:
- License agreement
- R&D collaboration

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