Actinides and Rare Earths
Room Ballroom BC - Session AC-ThP
Actinides and Rare Earths Poster Session

AC-ThP-1 Investigation of U-Ge Thin Films of Varied Stoichiometry*, Sonu* ***George Alex****, Oleksandr Romanyuk, Alexandr Andreev,* Institute of Physics CAS, Prague, Czechia*; Thomas Gouder, Frank Huber,* European Commission, JRC. Institute for Transuranium Elements, Germany*; Ivan Zorilo, Evgenia Chitrova,* Institute of Physics CAS, Prague, Czechia

The f-electron systems, particularly uranium-based compounds, exhibit unconventional ground states such as coexisting ferromagnetism and superconductivity. UGe_2 was the first uranium compound where this coexistence was discovered, marking a clear departure from conventional BCS theory [1]. Studying such materials in thin-film form offers a pathway to tune quantum correlations and explore emergent behaviors in reduced dimensions. In our study, we have synthesised U-Ge films of different stoichiometries by dc sputtering from a bulk, stoichiometric single crystal in an Ar atmosphere. By varying argon pressure and dc current on the target, we prepared a series of U-Ge thin films with varied stoichiometry. Photoemission spectroscopy studies (XPS and UPS) were performed on freshly prepared surfaces of the U–Ge thin films. The experimental data were compared with available DFT results for UGe_2, which employed the relativistic FPLO method and the FP-LAPW approach (WIEN2k)[2]. The samples were further characterized using XRD, magnetisation and resistivity measurements. Preliminary magnetisation measurements revealed features not observed in bulk. Low-angle XRD data suggests an expanded unit cell volume as compared to bulk.

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References

[1] S. S. Saxena et al. Nature 406, 587 (2000).

[2] M. Samsel-Czekała et.al,Intermetallics 19, October (2011).

AC-ThP-2 Deep Fission Track Analysis for Nuclear Forensics*, **Noam Elgad,*** Ben Gurion University Be'er Sheva, Israel*; Itzhak Halevy, Rami Babayew,* Ben Gurion Uni. Be'er Sheva, Israel*; Mark Last, Itzhak Orion,* ben Gurion Uni. Be'er Sheva, Israel*; Jan Lorincik,* research centre rez, Czechia*; Yaakov Yehuda-Zada, Galit Katarivas Levy,* ben Gurion Uni. Be'er Sheva, Israel*; Aryeh Weiss,* bar-ilan university, israel*; Erez Gilad,* ben Gurion Uni. Be'er Sheva, Israel

Abstract Summary:

Fission Track Analysis (FTA) is a key method in nuclear forensics for detecting fissile materials. This study proposes a novel deep learning approach to automate the segmentation and classification of star-shaped patterns in microscopic images, reducing the need for manual analysis.

Methodology:

Using a U-Net fully convolutional neural network, the research focuses on identifying star-like features in microscopy. A custom simulation tool generated artificial star shapes for training, alongside a new, diverse image database. Models were trained separately for small stars (under 60µm, fewer than 10 branches, no black center) and larger, more complex patterns. An adaptive thresholding method was introduced to improve data labeling and background noise filtering.

Key Findings:

The model reached 92.04% accuracy for small star classification and an ROC AUC of 0.84. For multi-class tasks, it achieved 86.3% accuracy in distinguishing star quality and 82.63% accuracy in recognizing stars with varying numbers of branches. Advanced classification models reached an AUC of 0.90.

Conclusion:

This study shows that deep learning can significantly enhance FTA by automating star pattern detection and classification, offering a more efficient and accurate tool for nuclear forensic analysis.

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