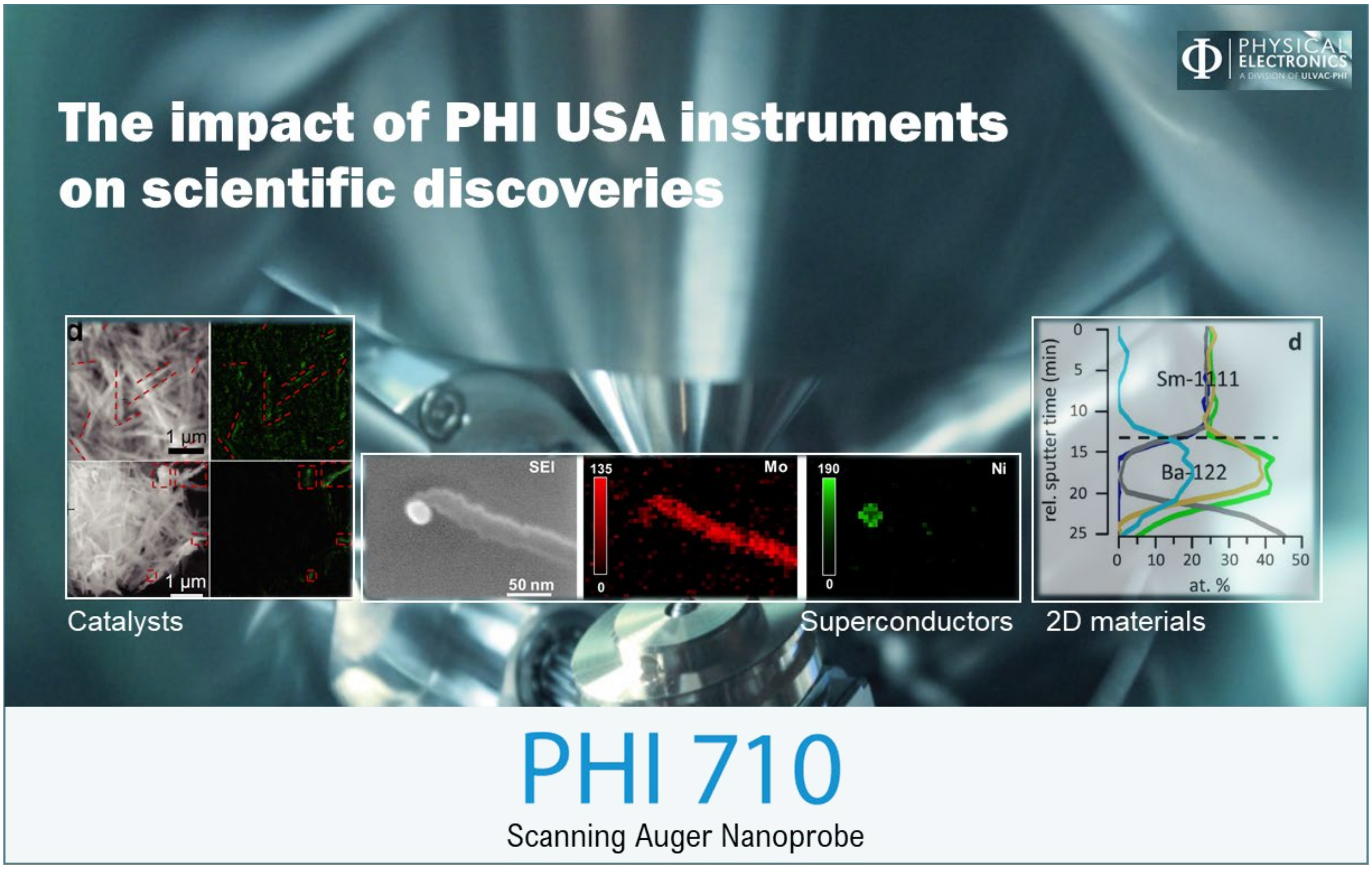

High-quality research publications are at the cornerstone of scientific advancement, understanding, and communication. Here, we review the year 2021 and the impact that the Physical Electronics Auger Electron Spectroscopy (AES) instrument has had in supporting scientific breakthroughs.

Over 1300 scholar publications, including peer-reviewed articles and book chapters, have been published in 2021 using PHI AES instruments, many of which were published in high-impact journals (Nature and Science group).

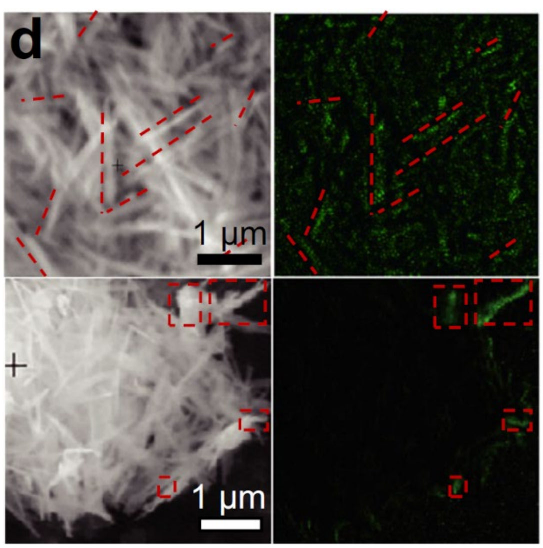

Figure 1: Scanning Auger mapping of Mn of fresh (bottom) and used (top) MnO2/Goe catalyst

PHI AES instruments were used to study a large range of materials for applications of high technological and research importance - solar cells based on perovskites[1], gallium arsenide[2], and silicon[3] ; prosthesis and medical implants[4-6]; 2D materials for quantum electronic devices[7]; novel catalysts for fuel cells, water splitting, energy storage[8-9], and the removal of organic micropollutants[10]; light emitting diodes[11-12]; thermoelectric materials[13]; deep-sea tribocorrosion of metal alloys[14]; low carbon steels for nuclear power plants and water-cooled reactors[15]; steel pitting corrosion[16]; additive manufacturing[17]; lithium-ion batteries[18-19]; and all solid-state batteries[20].

One paper published this year in Nature Communications as a collaborative study led by the National Engineering Laboratory for Industrial Wastewater Treatment at the East China University of Science and Technology is of impressive scientific merit. This work demonstrates the viability of a naturally abundant Fe/Mn-based catalyst to boost the future development of biomass products such as biofuel and enhance plastics degradation and wastewater treatment. Using the PHI 710 Scanning Auger Nanoprobe, Wang and coworkers[21] mapped the fresh and used Mn-based catalyst with a sub-micron spatial resolution to elucidate the mechanism of catalyst oxidation (Figure 1). High spatial resolution (<8 nm) elemental mapping using the PHI 710 instrument enabled superior visualization of this highly topographic material.

Another esteemed paper published this year in NPG Asia Materials by Haindl and coworkers[22] at the Tokyo Institute of Technology and the University of Glasgow utilizes the PHI 710 Auger instrument to study Fe-based superconductors. In this work, the interface chemistries of Fe-pnictide heterostructure layered materials were probed via Auger depth profiling. The Auger depth profiles reveal smooth and clean interfaces in undoped and Co^{2+} substituted cases, and an interface layer formation present in the case of excess O^{2-} during deposition (Figure 2). The ability to precisely depth profile these extremely thin layers highlights the capabilities of the monoatomic Ar^{+} ion gun equipped on the PHI 710 and demonstrates minimal sputter mixing and enhanced depth resolution.

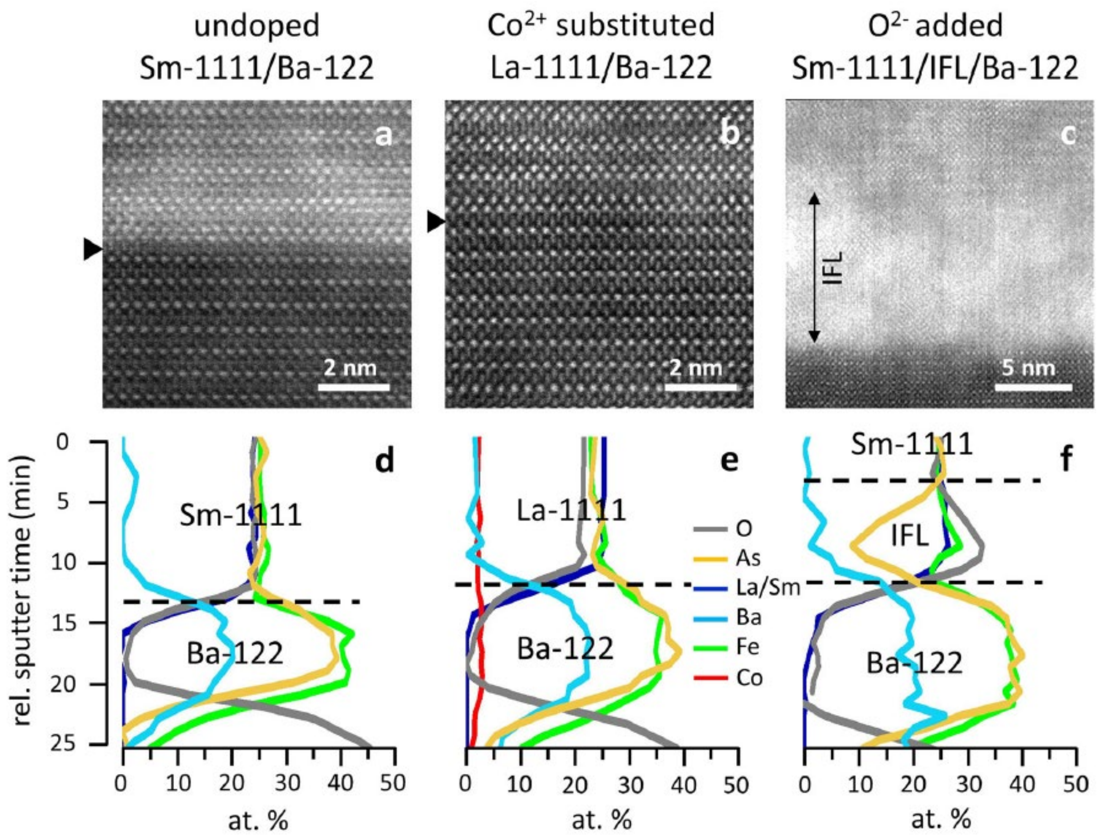

Figure 2: *STEM images of a. clean, undoped Sm-1111/Ba-122 interface, b. clean, Co^{2+}-substituted La-1111/Ba-122interface; c. interface layer (IFL) formation in Sm-1111/Ba-122 with excess O^{2-}. AES depth profiles across the interface for d. undoped Sm-1111/Ba-122, e. Co^{2+}-substituted La-1111/Ba-122, and f. Sm-1111/Ba-122 with excess O^{2-}.*

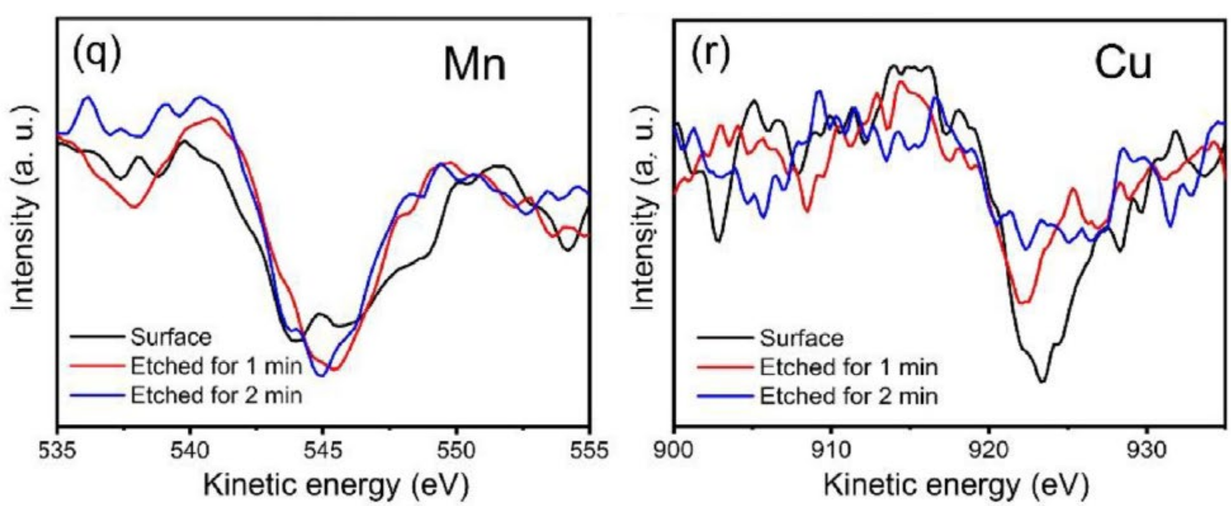

Figure 3: *In-depth AES spectra of Mn and Cu on a microscale grain of NaMnHCF after the ion-exchange modification*

A third high-impact publication this year in Electrochemica Acta by Zhao and coworkers[23] uses the PHI 710 Scanning Auger Nanoprobe to study Na-ion battery materials. In this work, the stability and performance of Na-ion battery technology was enhanced via surface modification of sodium manganese hexacyanoferrate (NaMnHCF) as a cathode material. Auger spectroscopy was used to analyze the in-depth chemical composition of the modified surface. The spectra reveal an increase in Cu composition and a decrease in Mn composition after sputtering ~20 nm into the material. This modification significantly improves the long-term stability of the electrode.

Physical Electronics is proud of the role the PHI 710 Scanning Auger Nanoprobe has played in achieving such prestigious scientific advancements over this past year. **Please visit the citations below for more details regarding the studies mentioned in this article.**

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