SS13 : 지속가능발전목표 달성을 위한 여성세라미스트 워크샵

SS13-1 | Carbon Mineralization Flagship Center: Response to the Global Climate Change

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The global climate change has led to a significant increase in recent surface temperatures, with global averages rising approximately 1.2 degrees Celsius. Addressing this significant increment is crucial through emission reduction and sustainable practices. The Carbon Mineralization Flagship Center converges its efforts on innovative and sustainable solutions in the realm mineralization and carbon utilization. With a steadfast commitment to addressing climate challenges, it places a strong emphasis on CO_2 mitigation, adaptation, and utilization. It specializes in various projects that harness the potential of coal by-products for valuable applications. Notable initiatives encompass rare earth element extraction from coal ash, the cutting-edge production of CSA (Calcium Sulfoaluminate) cement, and the development of zeolite materials derived from coal-related residues. By addressing environmental challenges while extracting value from industrial waste, the Carbon Mineralization Flagship Center exemplifies a commitment to advancing eco-friendly technologies and circular economy principles. Its comprehensive approach extends to a diverse array of applications, including but not limited to paper recycling, plastic recycling, and heavy metal stabilization. By ingeniously repurposing CO2 emissions and leveraging them for versatile purposes, it aligns with circular economy principles, fostering both environmental stewardship and industrial advancement. This mission-driven endeavor signifies the center's dedication to reshaping industries and practices for a more harmonious and sustainable future. Acknowledgement This research was supported by the National Strategic Project-Carbon Mineralization Flagship Center of the National Research Foundation of Korea (NRF) funded by the Ministry of Science and ICT (MSIT), the Ministry of Environment (ME) and the Ministry of Trade, Industry and Energy (MOTIE) (2017M3D8A2084752).

SS13-2 | Delving into the Essence of Matter through the Lens of the Electron Microscope

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One of the motive powers of the nanoscience development is availability of new instruments able to “see” and "control" at this scale. Currently, there are a large number of instruments that help scientists in the nano realm. Among them electron microscopy can be considered as the most powerful tool because it exhibits best spatial resolution (down to 0.5 Å) which is enough to resolve the individual atoms in a structure. Combined with complementary instruments, it produces various kinds of information of materials such as atomic crystal structure as well as chemical stoichiometry, electronic bonding, structural defects, magnetic structure and etc. Thus, electron microscopy is essential characterization tool for scientists who want to fabricate and deal nanomaterials. In this talk, I aim to introduce a case study that explores how the electrochemical properties of SOEC, the promising next-generation renewable energy technology, were elucidated through the lens of the microscope. Achieving continuous operation of the SOEC is a challenge due to the rapid delamination and degradation of the air electrode, which is not observed during the operation of solid oxide fuel cells. Delamination often leads to instantaneous catastrophic failure, making it challenging to obtain systematic information after complete failure. Here, we revealed how mechanical deformation and defects resulting from localized oxygen accumulation at the interface between the electrolyte and air electrode by various electron microscopy techniques including SEM, EPMA, FIB, precession electron diffraction in TEM, diffraction pattern analysis, and high-resolution TEM imaging, impair the electrochemical properties. By utilizing these integrated cutting-edge analysis methods, we were able to suggest a systematic degradation mechanism explaining how ions, lattice structure, nano-defects, and micro-sized cracks are interconnected, which differs from previous research

SS13-3 | Tunable magnetism and morphology of nanocups in ferroelectric thin films via co-exsolution of transition metals

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In complex oxides, the delicate tuning of the dimension, scale, shape, and stability of nanostructures is a key for the emergent properties. However, desired nanostructures are seldom attained in the thin film growth process. Here, we demonstrate that the active use of the exsolution process can be an efficient way for the tunable magnetism and morphology of

ferromagnetic nanocups in doped perovskite ferroelectric $Bi_{3.25}La_{0.75}Ti_3O_{12}$ (BLT) thin films. The unique formation of three-dimensional nanocup films is obtained by simple doping control of Co and Fe in BLT films. The multimodal analyses including XRD, SEM, TEM, MFM, and XMCD testify that the co-doping of Co and Fe reinforces the phase-separated nanocup formation which is similar to the $CoFe_2O_4$ spinel ferrimagnet. Employing the density functional theory calculations, we show that the different doping combination changes the relative exsolution energies of Co and Fe, which can eventually result in the selective formation of nanocup structures. Our study presents a simple and effective methodology for the engineering of nanostructure and multifunctionality in nanocomposite films.

SS13-4 | 세라믹 소재와 표면분석

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4차 산업혁명에 의한 초지능, 초연결 사회가 진행됨에 따라 반도체 수요가 급격하게 증가하면서 전자재료 및 에너지 소재와 관련한 다양한 소재 산업은 반도체를 이용한 첨단 산업의 기반이 되고있다. 이러한 첨단 소재 개발 및 소재 산업에 있어, 에너지 자원의 효율적 이용과 환경오염 저감에 대한 사회적 요구가 강화되면서 전통적 세라믹 소재를 비롯한 첨단 세라믹 복합소재에 대한 관심도 또한 높아지고 있다. 첨단 세라믹 소재 및 세라믹 부품 산업의 경쟁력 강화를 위해서 세라믹 소재의 물리적, 화학적 특성을 아는 것이 매우 중요하다. 세라믹 소재 표면의 물리/화학적 특성을 이해하기 위한 다양한 표면분석 방법 및 접근법, 그리고 표면분석에 의한 사례 및 응용에 대해 소개한다.