PSW1 : 극한환경 세라믹 복합소재 연구회

PSW1-1 | 지속 가능한 고전하 폴리이미드 기반 고효율 비접촉 마찰전기발전기

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we report on a new dielectric, a C_{60}-containing block polyimide (PI-b-C_{60}). This was realized by introducing C_{60} as pendent groups into a polymer backbone. When this dielectric was used in a non-contact mode triboelectric nanogenerator (TENG), it achieved high output power and reliable operation. Compared with perfluoroalkoxy alkane film-based TENGs, the TENG based on PI-b-C_{60} generated 4.3 times higher output power and a superior charge density of over 300 μC m^{-2} with a 3 times slower charge decay rate. These results are most likely due to the excellent charge-retention characteristics induced by the most negative electrostatic potential of C_{60} within the backbone, and these characteristics were confirmed by surface potential measurements. Furthermore, in the course of our work, two non-contact mode applications, a keyless electronic door lock system and a speed sensor with a tone wheel for a car, were developed. Without an ion injection process being needed, very sensitive and reliable operations of the speed sensor were successfully demonstrated, even under very humid conditions (~99% RH).

PSW1-2 | Electrical properties of two-dimensional electron gas at the interface of $LaAlO_3/SrTiO_3$ by a solution-based process

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The formation of a two-dimensional electron gas (2DEG) at the interface between $LaAlO_3$ (LAO) grown on a $SrTiO_3$ (STO) substrate has been observed, leading to active research on various novel electronic devices using complex oxide heterostructures. In most studies, however, LAO is typically grown on STO substrates using physical vapor deposition (PVD) such as pulsed laser deposition (PLD), necessitating vacuum equipment. As a result, this approach is costly and presents challenges for commercialization. Furthermore, the precise control of the composition of La and Al in LAO during growth using PVD methods is known to be difficult. Therefore, in this study, we present LAO thin films prepared by a solution-based method, and then observed the electrical properties of 2DEG. Specifically, we grew LAO on thermally treated STO substrates by utilizing a solution made from $La(CH_3COOH)_3$ and $Al(NO_3)_3$ dissolved in a 1:1 molar ratio, employing sol-gel techniques and spin coating. Throughout this process, we measured the electrical characteristics under varying thermal treatment conditions to investigate how the crystallinity and oxygen content of the LAO film influence the electrical properties of the 2DEG. Through this study, we aim to demonstrate the potential for easier control of 2DEG through a solution-based process, ultimately reducing production costs and enhancing applicability.

PSW1-3 | Engineering Microstructure in Optically Active P3HT-V_2O_5 Nanocomposite Films for Solar Battery Applications

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The batteries are known to be essential for the efficient use of solar energy. In general, however, an additional electronic system device needs to connect to a rechargeable battery, which is expensive and increases energy loss. Research on photoactive battery electrode materials continues because developing materials that can harvest and store solar energy at the same time can pave the way for smart and efficient energy utilization. In this presentation, we synthesized (poly(3-hexylthiophene) P3HT and V_2O_5 nanobelt that could be used as photoactive as well as battery electrode to develop solar batteries. P3HT and V_2O_5 were prepared by the Grignard metathesis and the hydrothermal synthesis method, respectively, and then their composite thin films were fabricated with two structures: P3HT/V_2O_5 bi-layer and bulk heterojunction P3HT/V_2O_5 structure. The photoelectric conversion efficiency and optical properties of each device were examined.