Natural rubber for triboelectric nanogenerator as new energy harvesting technology: synergistic effect of dielectric modulation and photocharge generation for output performance enhancement

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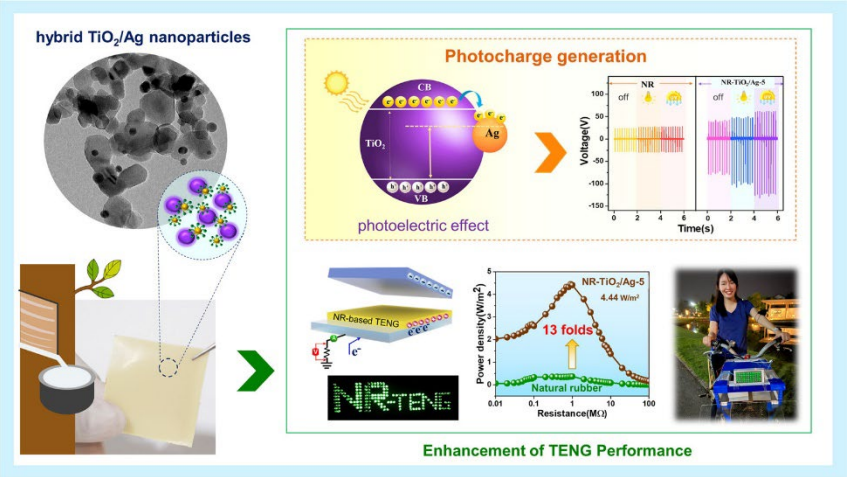
Triboelectric nanogenerators (TENGs) have attracted significant attention as an emerging technology for harvesting mechanical energy from the ambient environment and converting it into electricity through the combined effects of contact electrification and electrostatic induction. In this work, a natural rubber (NR)-based TENG with enhanced energy conversion performance was successfully developed. TiO_2/Ag hybrid nanoparticles were synthesized and incorporated into the NR matrix to improve the electrical output performance of the TENG. The developed approach facilitated the uniform dispersion of TiO_2/Ag nanoparticles within the NR polymer matrix, resulting in a significant improvement in the energy harvesting efficiency of the device. The NR–TiO_2/Ag TENG achieved a maximum power density of 4.44 W/m^2, which was approximately 13 times higher than that of the pristine NR-based TENG. The remarkable enhancement was attributed to the synergistic effects of dielectric interfacial polarization induced by Ag nanoparticles and photoinduced charge generation arising from the photoelectric properties of TiO_2, which collectively contributed to the increased triboelectric charge density. This work presents an innovative strategy for advanced TENG material design by integrating both mechanical and light energy harvesting into a single platform, thereby offering strong potential for future sustainable energy technologies and self-powered electronic devices. Moreover, this approach adds value to natural resources, aligns with the Bio-Circular-Green (BCG) economy model, and demonstrates significant potential to support the transition toward sustainable and environmentally friendly energy technologies.



References Bunriw, W., et al., TiO_2/Ag hybrid filler with synergistic effect of dielectric modulation and photocharge generation in the natural rubber-based triboelectric nanogenerator. Materials Research Bulletin, 2026. 193: p. 113682.

Biography (For Plenary, Keynote, and Invited Speakers)

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Personal History:
Currently, Assoc. Prof. Dr. Viyada Harnchana has been serving as a lecturer in the Department of Physics, Faculty of Science, Khon Kaen University since 2011. Her expertise lies in energy harvesting materials and triboelectric nanogenerator (TENG) technology. Her research interests focus on the development of advanced materials for clean energy production and self-powered electronics. She obtained her PhD in Materials Engineering from University of Leeds, where her research focused on the synthesis and microstructural characterization of materials using advanced analytical techniques. During the early stage of her career at Khon Kaen University, her research focused on the development of materials for energy harvesting and energy storage technologies, including dye-sensitized solar cells (DSSCs) and supercapacitors. Later, in 2015, she had the opportunity to conduct postdoctoral research at Sungkyunkwan University for one year under the Royal Scholarship granted by Her Royal Highness Princess Maha Chakri Sirindhorn. Her research focused on an emerging energy harvesting technology known as the triboelectric nanogenerator (TENG), which efficiently converts mechanical energy from the environment into electrical energy. This research area has gained widespread international recognition and has become a major foundation of her current research direction**.**

Research Keyword (3-5 keywords use commas to separate each word):
Natural rubber, Triboelectric nanogenerator, TiO_2/Ag hybrid nanoparticle, Energy harvesting