Final Year Project Showcase Batch-2020
Year 2024

Department: Materials Engineering Programme: Materials Engineering	
1	**Project Title:** Synthesis and Characterization of ZnO Nanostructures for Sensor Applications.
2	**Project Idea:** This project aims to develop a sustainable and efficient method for synthesizing zinc oxide (ZnO) nanoparticles using aloe vera extract. The synthesized ZnO nanoparticles are then incorporated into triboelectric nanogenerators (TENGs) to harvest energy from ambient mechanical vibrations.
3	**Process:** 1. **Synthesis of ZnO Nanoparticles:** Aloe vera extract is used as a reducing agent to synthesize ZnO nanoparticles. 2. **Characterization of ZnO Nanoparticles:** The synthesized ZnO nanoparticles is characterized using UV-visible spectroscopy and XRD to confirm the formation of ZnO nanoparticles. 3. **Fabrication of TENG (Triboelectric Nanogenerator):** A silicone film is used as the dielectric layer, and aluminum electrodes are attached to it. A spacer (foam) is placed between the electrodes to create a gap. 4. **Energy Generation:** When the TENG is pressed, the friction between the electrodes and the dielectric layer generates static electricity, which is stored in a capacitor.
4	**Outcome:** The project successfully demonstrated the green synthesis of ZnO nanoparticles using aloe vera extract and their incorporation into TENGs. The fabricated TENGs were able to efficiently harvest energy from ambient vibrations and store it in a capacitor.
5	**Evidence (Theoretical Basis)** The theoretical basis for this project is rooted in the principles of green chemistry and nanotechnology. The use of aloe vera extract as a reducing and stabilizing agent aligns with the principles of green chemistry, as it minimizes the use of harmful chemicals. The application of ZnO nanoparticles in TENGs is based on the triboelectric effect, which involves the generation of static electricity through contact and separation of materials.
6	**Competitive Advantage or Unique Selling Proposition** (Cost Reduction, Process improvement, Attainment of any SDG (Sustainable Development Goal), increase of market share or capturing new market or having superior performance over a competitor. In summary, any striking aspect of the project that compels the industry to invest in FYP or purchase it. Some detailed description is required in terms of how, why when what. You can select one or more from the following dropdown and delete the rest of them). Please keep relevant options, delete the rest of them, and correct the sequence
a	**Attainment of any SDG** (e.g. How it is achieved and why it is necessary for the region) **How:** The green synthesis of ZnO NPs using aloe vera aligns with SDG#12, (Responsible Consumption and Production) by minimizing the use of harmful chemicals and promoting sustainable resource management. **Why:** This approach is crucial for Pakistan, given its environmental challenges. It

	contributes to reducing pollution and promoting sustainable development practices.
b	**Any Environmental Aspect** (e.g. carbon reduction, energy-efficient, etc.) The use of a green method reduces the harmful chemical impact on the environment, especially compared to traditional chemical synthesis methods. TENGs offer a sustainable alternative to traditional energy sources, reducing reliance on batteries and consequently, carbon dioxide emissions.
c	**Cost Reduction of Existing Product** **Cost-effective Synthesis:** The green synthesis method using aloe vera could potentially be more cost-effective than traditional methods due to the availability and lower cost of natural resources. **Process Efficiency:** The use of a green synthesis method might simplify the overall process, reducing the need for complex purification steps or hazardous chemicals.
d	**Process Improvement which Leads to Superior Product or Cost Reduction, Efficiency Improvement of the Whole Process** (e.g. What is the issue is current process and what improvement you suggests) The project introduces a novel approach to the synthesis of ZnO NPs, potentially improving the overall process efficiency and reducing energy consumption compared to traditional methods. The green synthesis method result in ZnO nanoparticles with enhanced durability and stability, ensuring reliable performance over time and it is cost effective as compared to chemical and physical synthesis.
e	**Expanding of Market share** (e.g. how it expand and what is the problem with the current market The TENGs developed in this project could potentially expand the market for wearable technology and energy harvesting devices, addressing the growing demand for sustainable and efficient energy solutions.
f	**Capture New Market** (e.g. Niche market or unaddressed segment) The project could explore new market segments, such as remote sensing applications or self-powered medical devices, where the TENGs' ability to generate energy from ambient vibrations could be beneficial.
g	**Any Other Aspect** The project's focus on green synthesis and sustainable energy generation could contribute to a positive public perception and attract investment from environmentally conscious organizations and individuals.
7	**Target Market** (Industries, Groups, Individuals, Families, Students, etc) Please provide some detail about the end-user of the product, process, or service **Electronics Industry:** For powering wearable devices, sensors, and other low-power electronic components. **Healthcare Industry:** For powering medical devices and implants. **Automotive Industry:** For self-powered sensors and systems in vehicles. **Internet of Things (IoT):** For powering IoT devices and networks. **Building automation:** TENGs can be used to harvest energy from vibrations in buildings and power sensors or control systems. **Research Institutions:** For research and development in the field of energy harvesting and

	sustainable technologies.	
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