IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 4, March 2025

Photoelectricity: Principles, Applications, and Future Directions

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Abstract: *The photoelectric effect, a phenomenon where electrons are emitted from a material upon exposure to light, is a foundational concept in modern physics and quantum theory. Discovered by Heinrich Hertz in 1887 and explained by Albert Einstein in 1905, it confirmed the quantum nature of light and introduced the concept of photons. This breakthrough advanced our understanding of wave-particle duality and laid the groundwork for quantum mechanics. The paper examines the principles governing the effect, key experimental milestones, and its applications, including photovoltaics for solar energy conversion, photoelectron spectroscopy for material analysis, and photodetectors for imaging and communication. Despite its vast potential, challenges persist, such as efficiency limitations in solar cells and material constraints. Current research on innovative materials like perovskites and advancements in photon-based quantum technologies aim to overcome these barriers. By highlighting the photoelectric effect's enduring significance, the paper underscores its role in bridging classical and quantum physics and driving transformative innovations in energy, computation, and technology.*

Keywords: Photoelectric Effect, Quantum Theory, Photons, Photovoltaics

DOI: 10.48175/IJARSCT-24034