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Portable Anemia analysis using photovoltaic devices: Precision on the go!

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Anemia, characterized by reduced Hemoglobin (Hb) or red blood cell count, affects a quarter of the world' s population by diminishing the body's ability to transport oxygen. Quick diagnostic time is of the essence for this preventable and curable disease. The state-of-the-art anemia diagnoses are Automated Hematology Analyzers. Their high cost and long diagnostic time are the price for their accuracy in laboratory and clinical settings, making them inaccessible to third-world countries and remote locations. This study explores the potential of photovoltaic devices (PVs) as a cost-effective alternative for Hb sensing.

PVs create a repeatable electrical signal upon light absorption, with the short-circuit current (Isc) reflecting the change in illumination. Their durability and low cost make them suitable for point-of-care applications.

RGB LEDs illuminated Dye-sensitized solar cells (DSSCs) and Silicon-based PVs, measuring Isc responses to varying bovine Hb concentrations (0.1–1 mM). While lower than physiological levels, the selected concentration range allows for sensitivity evaluation within cost and solubility constraints. RGB allows for broad-spectrum wavelength analysis at a lower cost than monochromatic light, keeping the diagnostic tool affordable.

Preliminary results show consistent Isc at specific concentrations of Hb, a negative correlation between Isc and concentration, and a positive correlation between concentration and absorbance, which indicates that the increase in concentration reduces the available light for photocurrent generation. However, the current experiment lacks Hb specificity. Future steps will address this by functionalizing glass slides with a ligand to bind Hb and enhance specificity, allowing the real-time Hb concentration analysis for POC diagnostics. Our approach aims to deliver a reliable, low-cost diagnostic tool, addressing the global need for accessible healthcare.

Reference: Meng Z, Tayyab M, Lin Z, Raji H, Javanmard M. A Smartphone-Based Disposable Hemoglobin Sensor Based on Colorimetric Analysis. Sensors (Basel). 2022 Dec 30;23(1):394. doi: 10.3390/s23010394. PMID: 36616992.

Keyword-1

Hemoglobin

Keyword-2

Photovoltaic

Keyword-3

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