

Material Characterization via Smartphone-based Molecular Sensing

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The goal of this study is to deploy a smartphone-based molecular sensing module for civil engineering material characterization. This technology has the capacity to transform the current physical and chemical material properties methods. The proposed method is based on embedding a tiny near-infrared (NIR) spectrometer in smartphones or attach them to phones as external portable sensing units. The NIR technology is based on overtones and combinations of bond vibrations in molecules. In NIR spectroscopy, the unknown substance is illuminated with a broad-spectrum (many wavelengths or frequencies) of near infrared light, which can be absorbed, transmitted, reflected or scattered by the sample of interest. The illumination is typically in the wavelength range of 0.7 to 2.5 microns (700 to 2500 nm). The light intensity as a function of wavelength is measured before and after interacting with the sample, and the diffuse reflectance, a combination of absorbance and scattering, caused by the sample is calculated. The focus of this phase of the study is placed on deploying a portable smartphone-based NIR spectrometer to detect asphalt aging. This will be done through detecting availability of different components such as saturate, asphaltenic, resin, and aromatic. Arguably, the application of this technology is not limited to asphalt characterization. The sensor can be readily used by ordinary citizens for varied material characterization missions.

Keywords: Near-InfraRed, Smart phone, Material characterization