Gas Sensor Application with Photonic Crystal Fiber and Carbon Dioxide Sensor Design

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It’s very important to control and monitor gases that are produced by industrial applications since they can cause environmental pollution and health problems. Photonic Crystal Fiber (PCF) is a different kind of optical fiber and a new alternative for gas sensors due to its small sample volume, low transmission loss and high flexibility property. PCF’s are silica-glass fibers, made by periodic sequence of hollows along the fiber. By filling these hollows with optical liquids or gases, very sensitive sensors can be made. In this project, I aimed to design a sensitive sensor by filling the hollows with proper gases and liquids in the solid core PCF. For these applications, ethanol, methanol, toluene vapors and carbon dioxide was used. To observe carbon dioxide’s effects, ionic liquid (EMIMBF4), which carbon dioxide can dissolve in, was filled and then the experiments were repeated. It was observed that the transmission of light in PCF changed depending on the refractive index of the gas that was filled. So, it was understood that there was another gas besides the usual containments of air. My system could measure the absorption peak of toluene so it can be used as a toluene detector. After filling the fiber with ionic liquid, two steps occurred in the spectra of carbon dioxide so it can also be used as a carbon dioxide detector. The system was then customized as a carbon doxide sensor in a cost-efficient and portable way. This system can be specialized and easily used with the right light source which is efficient to see the absorption peaks, and proper liquids to detect intended gas. Making a carbon dioxide sensor by filling PCF with ionic liquid was never attempted before. Also the lack of carbon dioxide sensor studies supports the originality of our project.

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