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Fluorometrics Instruments LLC

Use of HCR (Hydrocarbon Resistant) Fiber Optic Oxygen Sensor in MMA

Technical Note

3/4/2020

- **Introduction:**
  Molecular oxygen can prevent free-radical chain polymerizations of unsaturated monomers Because of the well-known radical-scavenging behavior. A reduced polymerization rate and the loss of surface properties of a polymer film or coating will occur because of diffused oxygen in a polymerization system. However, there is not enough reliable data for oxygen concentration in organic monomers due to experimental and instrumental limitations of the commercially available techniques.
- **Summary**:
  - Hydrocarbon resistant (HCR) fiber optic oxygen sensor is used to monitor dissolved oxygen (DO) in Methyl methacrylate (MMA) liquid. HCR optical sensor is based on luminescence dynamic quenching of molecular probe by oxygen molecules. The compatibility, sensitivity and stability of the HCR oxygen sensor are demonstrated when immersed in MMA. MMA is an organic compound with the formula $CH_2=C(CH_3)COOCH_3$. This colorless liquid, the methyl ester of methacrylic acid (MAA), is a monomer produced on a large scale for the production of poly(methyl methacrylate) (PMMA).
- **Significance:**
  - Our HCR optical oxygen sensors are compatible with hydrocarbon-based chemicals such as pure organic solvents and fuels. To the best of our knowledge, no other product exists in the market that can survive in such environments.
  - Our HCR sensors are stable with minimal drift due to photobleaching and/or environmental effects when used in hydrocarbon-based mediums.
- **Sensor compatibility and short-term stability in MMA:** A fresh HCR probe was immersed in MMA for 5 hours. After 5 hours of soaking, decay time (tau) was measured as a function of time. Temperature was almost constant during the experiment at about 26 C. As shown in Figure 1, the sensor showed excellent stability with about 0.1 µs drift after 400 min (about 6.7 hrs) of continuous testing. MMA was saturated with Nitrogen gas afterwards. Initial tau value was 2.64 and it increased to 3.79µs upon bubbling Nitrogen in MMA. This shows that no physical damage was introduced in the HCR probe and sensitivity was restored.

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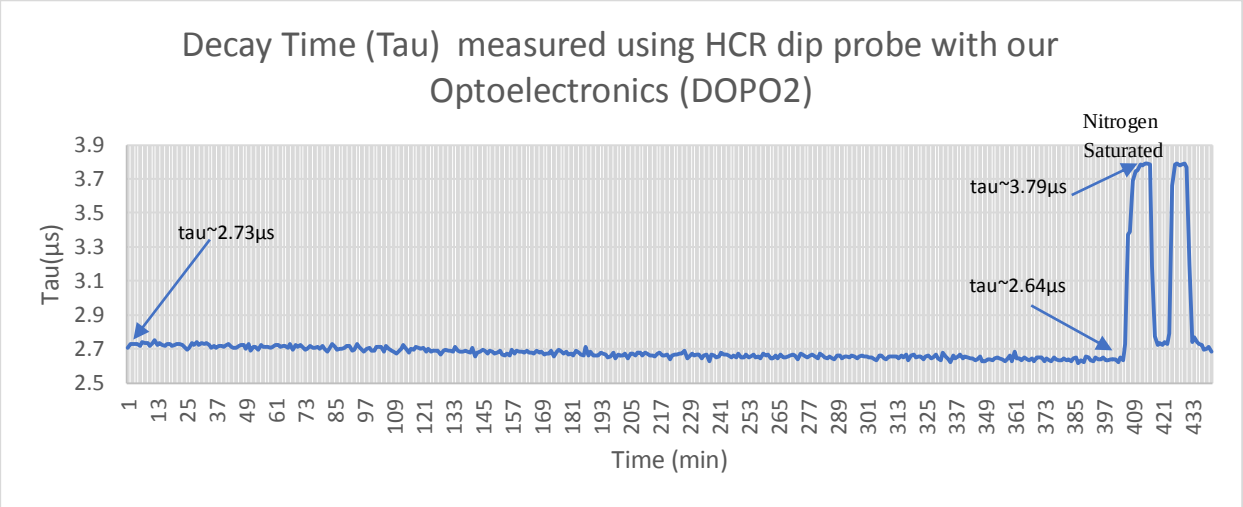

Fig. 1 Sensor Compatibility and Stability in MMA

- **Sensor performance in MMA**: We tested the sensor in MMA at zero oxygen (by saturation with nitrogen) and saturation with air. Figure 2 shows the sample response to oxygen in MMA at room temperature after calibration.

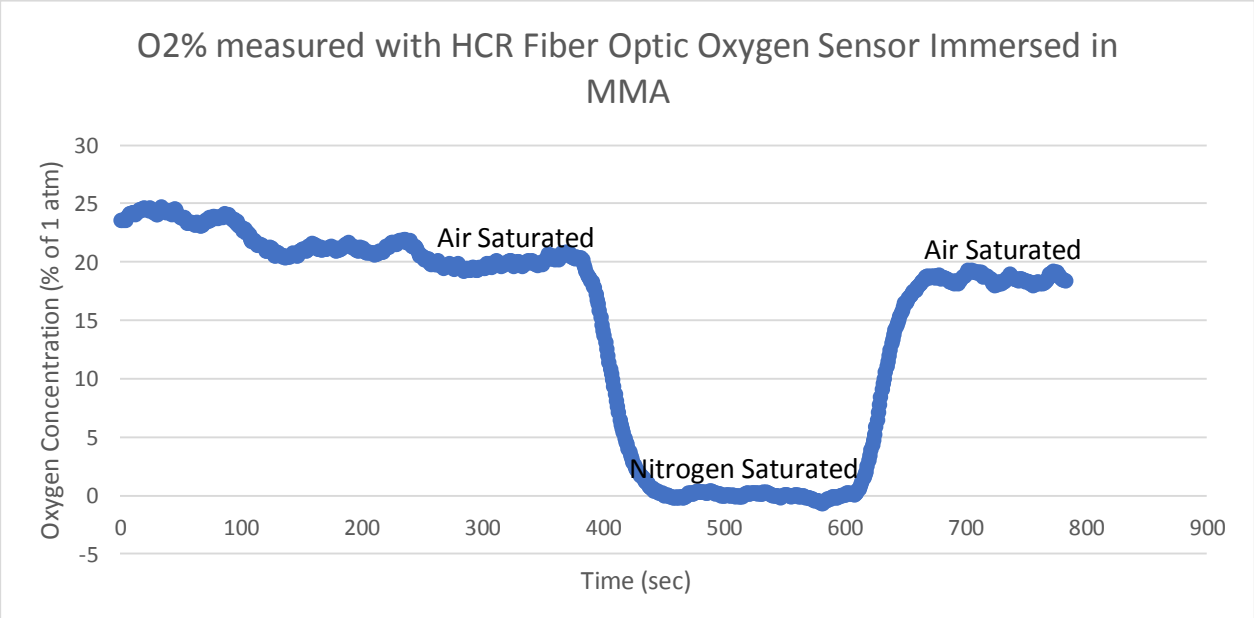

Fig. 2 Sensor Performance in MMA