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Research on Plasma Modified Fluoroether based Anesthesia Exhaust Gas Adsorption Materials

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The significant emissions of anesthesia exhaust gases from operating rooms pose serious risks to both global climate change and the health of medical personnel. In this study, a novel organic macroporous adsorbent material was successfully modified and fabricated using a nanosecond pulsed discharge plasma technique, enabling the efficient removal of sevoflurane—a representative fluorinated ether anesthetic—from medical exhaust. The effects of key discharge parameters, including treatment duration, peak pulse voltage, and working gas composition, on the adsorption performance were systematically investigated. Additionally, the mechanism of plasma-induced surface modification was elucidated using optical emission spectroscopy, revealing the role of active species in functionalizing the resin surface.

Comprehensive characterization of the adsorbent before and after plasma modification was conducted using scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), and Brunauer–Emmett–Teller (BET) surface area analysis. The results demonstrated significant increases in surface roughness, specific surface area, and porosity, along with successful grafting of functional groups such as –C–O and –COOH. Adsorption experiments confirmed that a 20-minute plasma treatment enhanced the adsorption capacity of the modified material by over 50% compared to the unmodified version.

This novel plasma-modified organic macroporous adsorbent shows outstanding potential for capturing fluorinated ether anesthesia gases in clinical environments. Its tunable pore architecture and tailored surface chemistry offer a promising and innovative approach to medical exhaust gas treatment and environmental protection in healthcare settings.

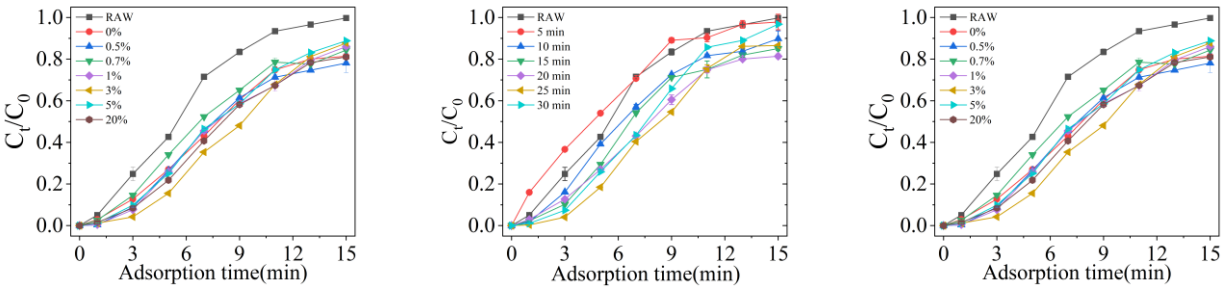

Figure 1. The breakthrough curves of the organic macroporous adsorbent material.