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Exploring impacts of fungal biofilms on porous media flow

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Filamentous fungi play critical roles in nutrient and carbon cycling¹, bioremediation², biofouling of engineered materials³, and infection of immunocompromised individuals^{4,5}. While these processes often involve porous media flows, we have limited knowledge on fungi-fluid interactions in pore spaces. This knowledge gap restricts our capacity to control and harness fungal activity for beneficial applications. To address this, we conducted microfluidic experiments to visualize fungal mycelia and fluid flow at pore scale. *Fusarium oxysporum* was chosen as the model fungus due to its wide-spread presence and pathogenic nature in immunocompromised individuals^{4,5} and crops⁶. Single straight channel and porous media polydimethylsiloxane (PDMS) microfluidic chips designs were fabricated to analyze fungal biofilm at a single- and multi-colony levels. In addition, while straight channels can reflect microchannels in physiological or medical systems, the porous media chip could mimic soil or filter environments. Pressure sensors were incorporated to assess permeability and preferential flow paths were visually confirmed through microscope. Additionally, confocal microscopy was employed to visualize and analyze the spatial patterns and structures of fungal mycelium. We anticipate that these findings will shed light on the interaction between fluid dynamics and fungal biofilms, offering valuable insights for predicting fungal activities such as nutrient transport and bioremediation, as well as informing strategies to control fungal contamination in agricultural and medical settings.

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References

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