Abstract Submitted
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Hydraulic regulation of air spreading in vascular plants using wetted cellulose membranes[1] JOOYOUNG PARK, TAESIK GO, JEONGEUN RYU, SANG JOON LEE, Pohang University of Science and Technology, BIOFLUID AND BIOMIMIC RESEARCH CENTER TEAM — Plants transport water through xylem vessels using strong negative pressure. Thus, the transport system becomes vulnerable to cavitation. For stable water transport, xylem structures have been evolved. Xylem vessels are interconnected by pit membranes consisting of cellulose fibers that function as hydraulic valves to regulate two-phase flows. In this study, the hydraulic roles of pit membranes to prevent spreading of air throughout xylem vessels were investigated using a model system consisting of channels embedding cellulose membranes. We hypothesized that pit membranes normally remain to be wetted in xylem vessels. We noticed in particular the hydraulic role of water film on air bubble spreading that has been overlooked previously. We elucidated the correlation of dynamic characteristics of air flow and pressure variations with the membrane thickness. As a result, the air spreading exhibits two types of dynamics: continuous and discrete spreading. In addition, the thickness of pit membranes affects the behaviors of water film captured by cellulose fibers. Thus, it is a crucial criterion for the reversible gating of further spreading of cavitation throughout xylem networks of under drought condition.

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