Scientists make breakthrough in ion-conducting composite membranes
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In contrast, composite membranes possess separately tuned selective layers supported on substrates. "A composite membrane with a very thin selective layer and a highly conductive substrate hopefully overcomes the trade-off between ion selectivity and conductivity and further improves flow battery performance," said Prof. Li.

To this end, the researchers utilized interfacial polymerization to fabricate a thin-film composite membrane. This membrane has an ultra-thin cross-linked polyamide selective layer and a highly conductive support layer. The ultrathin selective layer is only 180 nm thick. It offers a very short ion-transfer pathway and has very low area resistance.

The cross-linked polyamide has free volume between the size of hydronium and hydrated vanadium ions. Vanadium ions, due to their size, are highly resistant to crossover, thus endowing the membrane with high ion selectivity.

Flow batteries with a thin-film composite membrane could work at higher current density. This would allow the use of a smaller battery stack to generate higher power and reduction in the cost of battery stacks.

The proton transfer mechanism in polyamide selective layers can be further understood by utilizing the Grotthuss mechanism to make theoretical calculations of proton transfers along water chains and carboxyl groups. Results provide new ideas for designing advanced ion-selective membranes that can also be applied to flow batteries.
