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# Lignosulfonate biomass derived N and S co-doped porous carbon for efficient oxygen reduction reaction<sup>†</sup>

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## Abstract

Finding sustainable, active, inexpensive, and stable electrocatalysts to replace Pt-based materials for the oxygen reduction reaction (ORR) remains a significant challenge. Here we report the use of functionalized lignin biomass as both carbon and dopant source for the direct synthesis of N and S dual-doped carbon sheet networks with abundant mesopores and high surface area. The resulting N and S-doped porous carbon exhibits good activity, long-term durability, and high selectivity for metal-free oxygen reduction electrocatalysis, approaching the performance of 20 wt% Pt/C, the state of the art ORR catalyst. Our method using natural biological resources thus offers a promising way to produce very promising noble metal-free ORR catalysts with potential application in alkaline fuel cells and metal-air batteries.