Graphene-Based Sensing of Oxygen Permeation through Pulmonary Membranes

Lipid-protein complexes are the basis of pulmonary surfactants covering the respiratory surface and mediating gas exchange in lungs. Cardiolipin is a mitochondrial lipid overexpressed in mammalian lungs infected by bacterial pneumonia. In addition, increased oxygen supply (hyperoxia) is a pathological factor also critical in bacterial pneumonia. In this work we present the fabrication of a micrometer-size graphene-based sensor to measure oxygen permeation through pulmonary membranes. Combining oxygen sensing, X-ray scattering, and Atomic Force Microscopy, we discovered that mammalian pulmonary membranes suffer a structural transformation induced by cardiolipin. We observe that cardiolipin promotes the formation of periodic protein–free inter–membrane contacts with rhombohedral symmetry. Membrane contacts, or stalks, promote a significant increase in oxygen gas permeation which may bear significance for alveoli gas exchange imbalance in pneumonia.

Bio

Cecilia Leal is an Associate Professor and a Racheff Faculty Scholar at the Materials Science and Engineering Department at the University of Illinois at Urbana-Champaign (UIUC). She is also affiliated with the Materials Research Laboratory and the Beckman Institute. Cecilia received a M.S. in Industrial Chemistry from the University of Coimbra in Portugal and a PhD in Physical Chemistry from the University of Lund in Sweden. Cecilia was a Swedish Research Council postdoctoral fellow in Materials Science at the University of California in Santa Barbara before she started her appointment at UIUC in 2012. Her research interests lie at the intersection of materials science and physical chemistry with a focus on soft materials relevant in biology. Cecilia is the recipient of the 2019 UIUC Office of Provost Distinguished Promotion Award, the 2018 UIUC College of Engineering Dean's Award for Excellence in Research, the 2016 NSF CAREER Award, and the 2016 NIH Director's New Innovator Award.

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