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Self-Assembly of Protein Nanostructures to Enhance Biosensor Sensitivity[1] BRADLEY OLSEN, XUEHUI DONG, ALLIE OBERMEYER, MIT — The Langmuir adsorption isotherm predicts that the number of bound species on a surface at a given concentration will be directly proportional to the number of binding sites on the surface. Therefore, the number of binding events in a biosensor may be increased at a given analyte concentration if the surface density of binding domains is increased. Here, we demonstrate the formation of block copolymers where one block is a human IgG antibody or a nanobody and self-assemble these molecules into nanostructured films with a high density of binding sites. The type of nanostructure formed and the rate of transport through the protein-polymer layers are explored as a function of coil fraction of the protein-polymer conjugate block copolymers, showing optima for transport and assembly that depend upon the identity of the protein. For small enough analytes, binding to the antibodies and nanobodies is linear with film thickness, indicating that the entire film is accessible. Consistent with the enhanced number of binding sites and the prediction of the Langmuir isotherm, the films improve sensitivity by several orders of magnitude relative to chemisorbed protein layers used in current sensor designs. Current research is integrating this new material technology into prototype sensors.

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