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**Sequence-Structure-Property Relationships in Polymeric Proteins: Thermo-optic Properties and Device Applications** CHESTER SZWEJKOWSKI, University of Virginia, HUIHUN JUNG, ABDON PENA-FRANCESCH, Pennsylvania State University, JOHN TOMKO, University of Virginia, BENJAMIN ALLEN, Pennsylvania State University, SAHIN OZDEMIR, Washington University, PATRICK HOPKINS, University of Virginia, MELIK DEMIREL, Pennsylvania State University — Proteins are a natural source of building blocks for designing biological materials. Polymeric (i.e., repetitive) proteins are key to the creation of many designer materials with programmable flexibility, biocompatibility, superior optical properties, energy efficiency, and mechanical strength. We report the development of a novel technique to screen protein crystallinity quantitatively based on laser-probing. First, we show theoretically that the temperature dependence of the refractive index of a polymeric protein is correlated to its crystallinity. Then, we performed time-domain thermo-transmission experiments on purified semi-crystalline proteins, both native and recombinant (i.e., silk and squid ring teeth), and also on intact E. coli cells bearing overexpressed recombinant protein. Ultimately, this allows us to quantify rapidly the crystallinity of a protein sample using time-domain thermo-transmission spectroscopy by decoupling volumetric thermal expansion from its structural response at room temperature. Successful development of this technique for polymeric proteins will have a significant impact on multiple applications in various fields (e.g., materials science, agriculture, neurological diseases and medicine) and open new avenues of protein research.

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