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Thermal-mechanical behavior of self-assembled nanoparticle membranes YIFAN WANG, SEAN MCBRIDE, University of Chicago, XIAO-MIN LIN, Argonne National Laboratory, HEINRICH JAEGER, University of Chicago — Monolayers composed of colloidal nanoparticles with a thickness of less than ten nanometers have remarkable mechanical strength and can suspend over micron-sized holes to form free-standing membranes. However, previous measurements on mechanical properties of these monolayers were typically carried out at room temperature. Here, we report the first systematic experimental study of the stiffness of free-standing nanoparticle membranes as a function of temperature. At room temperature and below, these membranes exhibit reversible changes in stiffness, which increases with temperature. At higher temperatures irreversible membrane relaxation was found. This work provides a better understanding of the sub-nanometer scale ligand interactions in self-assembled nanoparticle membranes, and opens up opportunities for using these membranes as thermal-mechanical devices.

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