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Optical Characterization of Temperature- and Composition-Dependent Microstructure in Asphalt Binders ADAM RAMM, Department of Physics, The University of Texas at Austin, SAKIB NAZMUS, AMIT BHASIN, Department of Civil Engineering, The University of Texas at Austin, MICHAEL DOWNER, Department of Physics, The University of Texas at Austin — We introduce noncontact optical microscopy and optical scattering to characterize asphalt binder microstructure at temperatures ranging from 15 to 85°C for two compositionally different asphalt binders. We benchmark optical measurements against rheometric measurements of the magnitude of the temperature-dependent bulk complex shear modulus $|G^*(T)|$. The main findings are: (1) Elongated (5 x 1 μm), striped microstructures (known from AFM studies as "bees" because they resemble bumble-bees) are resolved optically, found to reside primarily at the surface, and do not reappear immediately after a single heating-cooling cycle. (2) Smaller (1 μm^2) microstructures with no observable internal structure (hereafter dubbed ants), are found to reside primarily in the bulk, to persist after multiple thermal cycles and to scatter light strongly. Optical scattering from "ants" decreases to zero with heating from 15 to 65°C, but recovers completely upon cooling back to 15°C, albeit with distinct hysteresis. (3) Rheometric measurements of $|G^*(T)|$ reveal hysteresis that closely resembles that observed by optical scatter, suggesting that thermally-driven changes in microstructure volume fraction cause corresponding changes in $|G^*(T)|$.

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