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Water and Defect Detection Beneath Rubber Using Terahertz Reflection Tomography

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Royal Canadian Navy VICTORIA Class submarines must operate with enhanced stealth using rubber acoustic tiles over their steel hulls to provide SONAR cloaking and absorb emanating noise. These tiles, as well as a connective grouting compound, form an opaque covering of virtually the entire hull surface. In evaluating the integrity of the hull as a pressure vessel it is of paramount importance to discern states of deterioration and corrosion of the underlying steel, in addition to water seepage and delamination within the tiles and grouting interfaces themselves. With a rubber transmission window at approximately 80 GHz, Terahertz (THz) sensing methods have shown promise for probing these slab-like structures in laboratory. In practice, non-destructive examination must be done from the outside surface of the hull with the radiation reflecting off of the metal subsurface, thus passing through the strongly absorbing cloaking layers twice. Working in conjunction with Defense Research and Development Canada (DRDC) towards a practical hull inspection technology for VICTORIA Class submarines, we have investigated the potential applications of THz reflection tomography to water, corrosion, and delamination detection beneath opaque rubber media. We have investigated 1" thick rubber tile analogous to those used on the submarines using a Brewster-angle reflection terahertz time-domain spectroscopy apparatus.

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