SUEX as an Anti-Reflection Coating for Silicon Lenses for mmW and THz Applications

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Lens-integrated antennas have been extremely popular for millimeter-wave (mmW) and terahertz (THz) sensor and spectroscopy applications. For narrowband applications, the double-slot antenna topology is widely preferred, whereas for broadband spectroscopy applications, self-complementary designs are used to realize photoconductive antennas. The dielectric lenses used in these antennas are usually made of high-resistivity silicon (HRSi), due to the low material loss. However, the high dielectric permittivity of HRSi (ε_r=11.7) results in significant impedance mismatches with air, leading to a mere 46% transmission of the incident power from within the lens into free-space. Thus, anti-reflection (AR) coatings are badly needed to minimize the reflection losses at the silicon-air interface.

For THz frequencies, the required thickness for AR coatings is on the order of 100s of microns, which cannot be readily achieved with conventional thin film deposition techniques. For example, vacuum-deposited Parylene polymer was considered as an AR coating on silicon lenses (A. J. Gatesman, J. Waldman, M. Ji, C. Musante, and S. Yngvesson, IEEE Microwave and Guided Wave Letters, pp. 264-266, 2000). Also, there have been studies showing different types of AR coatings such as the direct machining of mixed epoxies on lens or laser machining of anti-reflective structures onto lens surface (Tom Nitta, et al., Journal of Low Temperature Physics, 176.5-6 2014). Nevertheless, many other polymers are emerging as natural and cost-effective choices, possibly being a good fit as an anti-reflection coating material.

Particularly, SUEX is a new line of thick, dry photoresist epoxies, recently-developed by DJ MicroLaminates, which can be readily used for AR coating applications, thanks to its favorable material properties and ease of application. Here, we present a 150-μm-thick cured SUEX dry film to realize an effective AR layer for HRSi lenses in the 220-330 GHz band. SUEX can be easily laminated onto the spherical lens surface and leads to an improved transmittance as high as **90%** at 270 GHz. Details of lens coating process and measurements will be presented at the conference.