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Non-destructive and Precise: Raman Spectroscopy for Modern Semiconductor Technologies

Raman spectroscopy has become an increasingly valuable tool in the semiconductor industry, offering a highly sensitive and non-destructive method for characterizing materials at the micron and nano scales. With a lateral resolution of better than 300 nm, this technique spans a range of applications, including the analysis of minute organic residues on various surfaces, as well as the examination of crystal structures, intrinsic mechanical stresses, and strain in a range of semiconductors, such as silicon [1], gallium nitride [2], and silicon carbide [3]. Furthermore, Raman spectroscopy is also being applied to the study of emerging two-dimensional materials, including graphene [4].
A detailed understanding of mechanical stresses in semiconductor devices is essential for the development of new die attach processes for high-power modules as well as to consider the trend toward chip thinning and more complexly structured chips. Another advantage of Raman spectroscopy is the possibility to use laser light from different spectral ranges (visible, UV, NIR). Especially, the use of laser light exceeding the visible range enables the analysis of surfaces and atmospheres inside transparent cavities.
Our presentation will provide an overview of the most common Raman applications at Infineon, showcasing the technique's versatility.

References

[1] I. De Wolf, et. al, IEEE TRANSACTIONS ON COMPONENTS AND PACKAGING TECHNOLOGIES, VOL. 28, Theoretical and Experimental Raman Spectroscopy Study of Mechanical Stress Induced by Electronic Packaging (2005)
[2] C. Wetzel, et. al, Raman and IR studies of GaN (1998)
[3] M. De Basio, et. al, Micro-Raman spectroscopy as a Tool for the Characterization of Silicon Carbide in Power Semiconductor Material Processing (2017)
[4] L. Banszerus, et. al, IOP Science, Identifying suitable substrates for high-quality graphene-based heterostructures (2017)

Figures

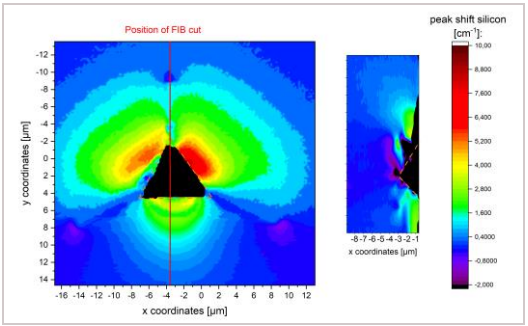

Figure 1: Shift of silicon peak measured around a Berkovic Indent

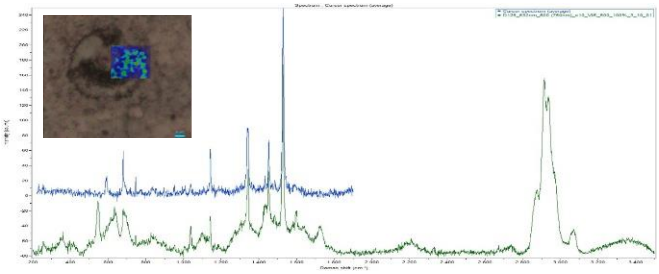

Figure 3: Raman measurement to identify surface contaminations