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Significance of self-absorption for emission spectral lines¹

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Dublin City University — Accurate optical measuring techniques of spectral lines are needed for low pressure plasma semiconductor manufacturing diagnostics. One spectral line broadening problem which has been widely overlooked and its importance neglected is self-absorption. Self-absorption is an effect when a photon emitted by an atom may be absorbed by a different atom before it escapes from the source. In this study the method used to quantify the self-absorption involves changing the optical path length of the measured OES plasma spectral emission. This is achieved by taking OES measurements from two different viewports on the reactive ion etch (RIE) plasma chamber, one directly on top of the plasma chamber and the other on the side of the chamber, both differ in optical length. If the increase in signal intensity changes corresponding to optical length, there is no self-absorption. The experiments are performed in an RIE chamber, 13.56 MHz with maximum RF power of 600 W, Ar - O₂ mixture. Almost all the measured spectral lines have been affected by self-absorption e.g. the Argon 750 nm spectral line has its intensity affected by up to 40%. In the case of Actinometry calculation, taking into account Ar and O₂ emission, correction of self-absorption could change the final result up to 20%.

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