Measurement of ion energy distribution according to positive voltage applied to the substrate

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Recently, we have carried out a study using plasma electron annealing (PEA) as an annealing method for crystallizing amorphous silicon (Thin Solid Films 622 (2017) 111). The PEA method for crystallization takes advantage of the electrons inside the plasma by applying positive bias voltage. In PEA, the electrons near the substrate are accelerated towards the substrate while positive pulse is applied to the substrate. Consequently, the energetic electrons collide with the substrate, so that the surface of sample on the substrate can be heated rapidly, but simultaneously the plasma potential also increases due to the incident electrons to the substrate. Increased plasma potential can lead to high energy ions and the incident ions to the substrate during the pulse OFF time affect the substrate temperature. Also, high energy ions that collide with the chamber walls generate unwanted impurities. In this study, the ion energy distribution (IED) according to positive voltage applied to the substrate was measured. Ar, H2 and He gases were used, and the IED was measured under DC and pulse conditions. In the pulse condition, the IED according to the change of frequency and duty ratio was measured. As a result, as the positive voltage increased, the ion energy increased in order of ion mass, small to large (Ar>He>H2). At low pulse frequency condition, the IED has two peaks, but as the frequency or duty ratio increases, the IED shifted towards high energy.