VI$^{th}$ International Workshop on Plasma-Based Ion Implantation

Abstracts

Website: https://www.jammpolyads.grenoble.fr conference

Grenoble, France
June 26-28
In-situ Monoking of Plasma-Based Ion Implantation by Measuring Secondary Electron Emission Coefficient

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We have developed a novel technique for direct measurements of secondary electron current at a processed target during plasma-based ion implantation (PBII), which allows us to make an in-situ measurement of secondary electron emission coefficient (SEEC) of the target surface[1]. In this paper, the technique is applied to monitoring of time variations of the SEEC, and we investigate possibilities of end point detection for precise control of the PBII processes. A pure or a 5%-oxygen-mixed Ar plasma is produced by 13.56 MHz inductively-coupled discharge at an operating total pressure of 16 mTorr. The base pressure before the operation is in the order of 10⁻⁸ Torr. A 2-4 kV negative high voltage pulse is applied to a spherical copper target with a duration of 10 μs. In addition to the secondary electron current I₂s, the total target current I₁, is measured, and the SEEC γ is derived from the relation of I₁ = (1+γ)I₂s. For the both cases of the Ar and the Ar/O₂ plasma, the SEEC gradually increases with the process time and saturates within 10-20 min. However, the Ar/O₂ plasma has a higher saturation value of γ than the pure Ar plasma: γ >10 for the Ar/O₂ plasma and γ ~5 for Ar plasma. Depth profile of implanted oxygen measured by XPS analysis revealed that the O₂ mixture into the plasma enhances deep oxygen implantation, and that the time variation of the measured SEEC corresponds well to that of oxygen implantation. These results suggest that the present SEEC measurement will be applicable to end point detection of the PBII process. [1]K. Nakamura et al: 5th Int. Workshop Plasma-Based Ion Implantation (Kyoto, 1999) O-16

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Monitoring of Charging Effects in Plasma Immersion Ion Implantation of Semiconductors

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Plasma immersion ion implantation (PIII) has been shown to be an effective semiconductor processing technique such as the formation of silicon-on-insulator and surface modification of III-V semiconductors. Owing to the semiconducting characteristics of some of the materials, there may be charging during PIII. This may adversely affect the implantation processes giving rise to for example, broader energy distribution of the implanted ions and damage in the materials that can affect the electrical characteristics of the materials. In this paper, we describe in-situ monitoring of this charging effect during PIII by using two high-voltage capacitor dividers. The first one is used to measure the bias voltage of the silicon wafer holder (connected to the high-voltage feedthrough) and the other one detects the potential of the copper plate bonded to the wafer surface using electrically conducting glue. Using this device, the effects of the implantation parameters including implantation voltage, plasma density, pulse duration, etc on electrical charging is experimentally investigated and a one-dimensional theoretical model is used to analyze these results.