IonScan 800 – Ultra-precise Wafer trimming Technology

Many applications in semiconductor technology are characterised by extreme requirements in terms of film thickness homogeneity. Here **Dr. Michael Zeuner, Matthias Nestler** and **Dr. Dietmar Roth** introduce a new method of local film thickness trimming and its technical implementation.

Over the past years, ion beam technologies have increasingly found their way into material processing in optics and semiconductor technology. The reason for this success is based on the characteristics of the ion beam processes outbalancing alternative technologies in terms of quality. In ion beam methods, the incident angle of the ion beam may be adjusted in a defined manner. However, the process is characterised by a narrow ion energy distribution, controllability of the ion beam composition, as well as a high time and spatial constancy of the ion flow. Consequently, ion beam methods are mostly used for large area milling processes whose removal depth accuracies get close to the atomic scale. These procedures enable homogeneous removal or structuring with outstanding anisotropy characteristics across the whole substrate surface.

Ion beam trimming technology

Ion beam technologies not only allow a homogeneous substrate removal, but also locally resolved etching by controlling the local ion dose. Upon this dose, it is possible to correct inhomogeneities of particular characteristics. When correcting film thickness or step height values of a structure, an error function gets etched down to the required function. The terms "ion beam trimming"or "ion beam figuring" were introduced for this technique.

Ion beam trimming can be performed with either an aperture- or a residence time method. In the aperture method, a large area ion beam gets shaped with a shutter system or masks in its

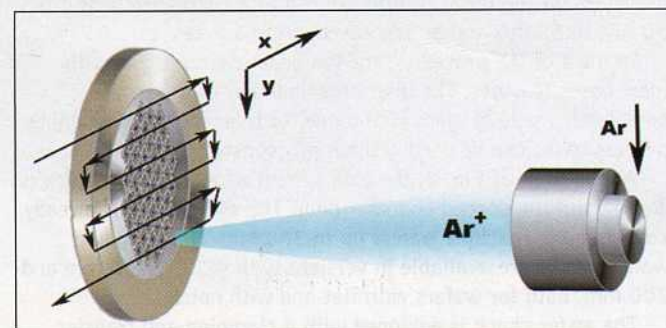

Fig. 1: Function diagram of film thickness trimming by residence time method

Fig. 2: General view of the IonScan 800

temporal progression. The local ion dose is controlled in a defined way by variable aperture windows of different size which are chronologically consecutive. However, the technical effort implementing the aperture method is notably high. At the same time, the process rates are low due to blanking a large share of the ion beam. Consequently, the aperture method is normally out of the question for use in a production environment.

It is much easier to control the local removal characteristics by means of the residence time method. The residence time method uses a focused ion beam, which is moved in relation to the substrate to be corrected according to a defined motional strategy. It is possible to calculate the required residence time values at the corresponding positions and the appropriate motional mode being aware of the static etch profile of the ion beam. The basic process arrangement of the residence time method is shown in Fig. 1.

The residence time method does not require any additional aperture or shutter systems. It always utilises the ion beam to its