In situ real-time characterization of block copolymer self-assembly processes by GISAXS

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Resume : Directed self-assembly (DSA) of block copolymers (BCP) is considered by the semiconductor industry as one of the main alternative for next generation technological nodes. Further advances towards the incorporation of DSA-based technologies require a deep understanding of the self-assembly mechanism to find optimal process conditions (i.e. kinetics of self-assembly) and decrease the defect density. In order to evaluate the potential of BCP-based technologies, new metrology methods with sufficient spatial resolution and capable to probe large analysis areas for statistical studies must be applied. In this scenario, grazing incidence small-angle X-ray scattering (GISAXS) is a reliable method for its high spatial resolution and fast temporal response over large scanning areas. In this contribution, we show the characterization of dynamics of thin film BCP self-assembly processes by GISAXS. First, the self-assembly of different PS-b-PMMA systems has been studied in real time by thermal annealing while GISAXS data is recorded (i.e. in-situ testing). Different annealing conditions have been analyzed, allowing us to monitor the order-disorder transition of the BCP films. Furthermore, this technique has been also used for the characterization of sequential infiltration synthesis (SIS). An evolution of the maxima at Yoneda band was observed in the samples attributed to the incorporation of aluminium oxide into the PMMA block, as a function of number of cycles and process conditions.