Verification of performance of HSI in evaluation of ALD coatings

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The HSI system was implemented in the glovebox of the S2S pilot line at Fraunhofer IAP. Different series of oxide depositions (Al_2O_3 , TiO_2) on silicon wafers as reference, glass and PEN substrates on sizes up to 150 mm x 150 mm were prepared to evaluate their thickness, homogeneity and morphology and to elaborate the sensitivity of the setup and compared with SoA offline systems. ALD layers of different composition were prepared on different substrates (Si-wafers as reference, glass, polymer substrates) on sizes up to 150 mm x 150 mm. The spatial homogeneity of these layers was evaluated by HSI and compared to off-line characterization by optical spectroscopy, lab-based XRR (FhG-FEP) and spectroscopic ellipsometry and synchrotron based spatially-resolved XRR (resolution few 100 µm, TUDO). This spatial information from off-line characterization is obtained by the investigation of different sample areas, which was be correlated to the HSI results. Furthermore, a “quasi in-situ” test on Al_2O_3 and TiO_2 with nominal deposition differences of 1 or 2 nm were prepared and measured to get information of the sensitivity of the HSI to thickness changes as low as 1 nm. Another test was prepared with Al_2O_3 deposition with conditions out of the optimum process conditions. Besides the thickness evaluation the samples were investigated with XPS to determine remaining carbon content and sense how sensitive HSI can image insufficient process conditions. In order to integrate the HSI into the daily work at FhG-IAP in processing of flexible electronic stacks several functional layers deposited by spincoating were investigated to which extend complex structures will be sensitive for HSI investigations such as complete OLED layer stacks including the ALD thin film encapsulation layer (together with NEO). Thus, we were able to characterize layers of PEDOT:PSS, an often used charge carrier material in organic electronic devices, as well as PVK (poly N-vinylcarbazol), a functional polymer, which is part of the active layer in OE devices.

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