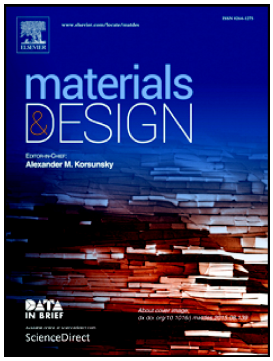

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Identification of Interfacial Transition Zone in Asphalt Concrete based on Nano-scale Metrology techniques

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Abstract Identifying the nature of the region where the mastic meets the aggregate surface (interfacial transition zone, ITZ) is very helpful in understanding some mechanisms that govern the fracture behavior of asphalt pavement. However, it is rather difficult to identify and study ITZ by bulk techniques. In this study, nano-scale metrology techniques, including nanoindentation (NI), field emission scanning electron microscope (FESEM), and energy dispersive X-ray spectrometer (EDS), were employed to explore the micromechanics, microstructure, and chemical properties of ITZ. Experimental results show that the ITZ exists in asphalt mixture and the thickness of ITZ is in the range from 5 μm to 20 μm. The modulus value of ITZ was found between that of the aggregate and the mastic. The microstructure of ITZ was observed to be more compacted than that of mastic. This study contributes significantly to the nano-scale characterization of ITZ in asphalt concrete, which can provide more realist inputs for the micromechanical models.

Key words: interfacial transition zone; asphalt mixture; nanoindentation; energy dispersive X-ray spectrometer (EDS); image processing technique.

1 Introduction

Mechanisms of interactions at asphalt-aggregate interface are of vital importance because the asphalt must adhere to the aggregate for the adhesive binding action to keep the aggregate particles and hence pavement together. During the mixing and compaction process, when fillers coated by asphalt binders are suspended in the mix (asphalt mastic comes into being) and they get into very close vicinity of a much large aggregate particle, then physical, chemical, and mechanical actions may occur between the mastic and aggregate material, leading to a narrow region formed around the aggregate particles. This region can be called as the interfacial transition zone (ITZ).

Identifying the nature of the region where the mastic meets the aggregate surface is very helpful in understanding some mechanisms that govern the fracture behavior of asphalt pavement, since this region is always recognized as a weak link, whose strength are relatively low. Matzenmiller and Gerlanch found that the interfacial bond strength has an effect on the overall behavior of composite materials [1]. The research of He et al. showed that the fiber/matrix interfacial properties change the dominant fiber failure type from rupture to pull-out mode, and thus affect the strain-hardening behavior [2]. Wang et al. gave that if the bonding between two materials is unstable, or there is some damage at the interface, composites cannot be used properly [3]. To improve the mechanical strength of composites, some special additives were also

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