INVESTIGATION OF THE AGING BEHAVIORS OF MULTI-DIMENSIONAL NANOMATERIALS MODIFIED DIFFERENT BITUMENTS BY FOURIER TRANSFORM INFRARED SPECTROSCOPY

Objective

To study the influence of multi-dimensional nanomaterials (nano-zinc oxide and vermiculite) on thermal-oxidative and photo-oxidative aging behaviors of different types of bitumen. The FTIR spectroscopy was utilized to characterize the chemical functional groups of different bitumens with or without multi-dimensional nanomaterials before aging.

Sample Preparation

Bitumens (70#, 90# and 110#) were heated to 150ºC until they flowed fully. Multi-dimensional nanomaterials (1% nano- ZnO + 3% OEVMT by weight of bitumen) were interfused into bitumens. The mixtures were sheared at 4000 r/min for 1 h. Subsequently, they were stirred at 2000 rpm for 1.5 h. Finally, resultant bitumens were dissolved into carbon disulfide (CS_2). The infrared lamp was used to get rid of the CS_2 solvent.

Data acquisition

The transmission mode of operation FTIR was used in this research. Test range: 4000–400 cm^{-1}; Number of scanning: 32; Resolution: 4 cm^{-1}.

Representative figure & results

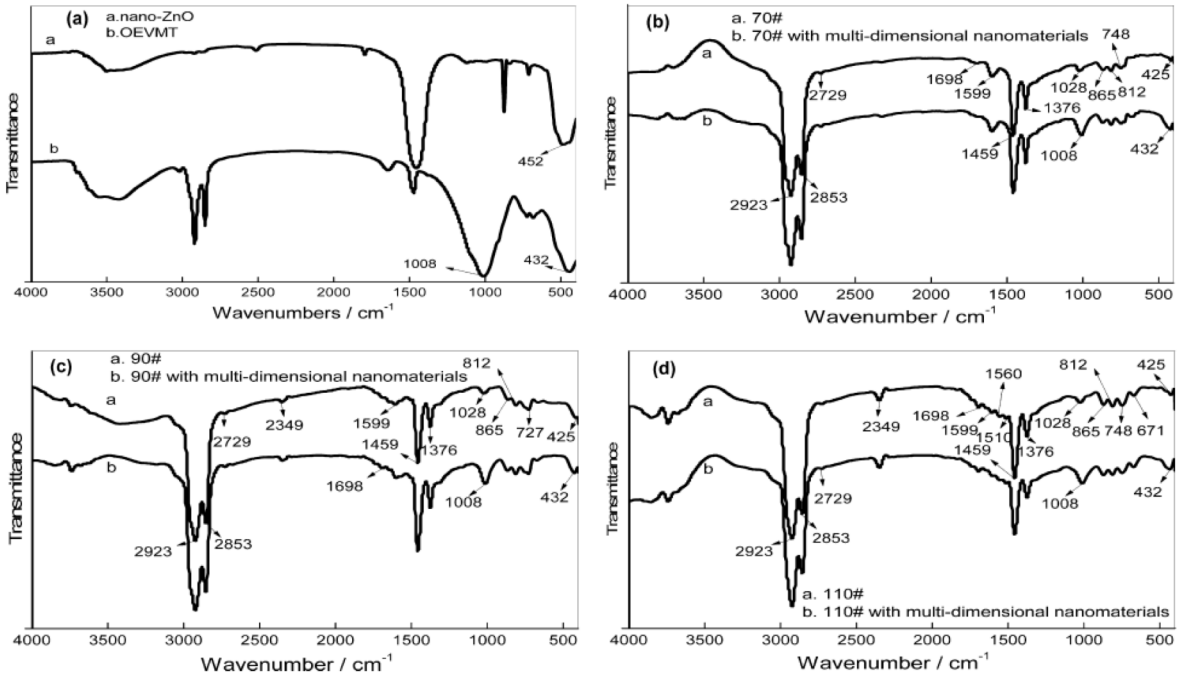

Fig. 1. FTIR of nanomaterials and three types of bitumen before and after multi-dimensional nanomaterials modification: (a) nanomaterials, (b) 70#, (c) 90# and (d) 110#.

Conclusion

It can be concluded that there are some differences in chemical functional groups between 110# and 70# or 90# bitumens. For three types of modified bitumen, two new absorption peaks at 1008 cm^{-1} and 432 cm^{-1} appear, which are attributed to the stretching and bending vibration of Si-O-Si in vermiculite. But the absorption peak at 452 cm^{-1} caused by bending vibration of nano-ZnO overlaps with the absorption peak provided by bending vibration of Si-O-Si (vermiculite at 432 cm^{-1}), thus the two absorption peaks are difficult to distinguish. As a result, is determined that a large amount of vermiculite exists in the FTIR sample, which in turn can be speculated that vermiculite has good compatibility with three types of bitumen. However, the existence of nano-ZnO in the FTIR sample can't be determined.