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Transformation of vanadyl porphyrins in heavy residue during thermal upgrading under hydrogen

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Transformation of vanadyl porphyrins in the petroleum heavy residue during thermal upgrading under hydrogen was investigated. Effect of reaction time, hydrogen pressure and elemental sulfur on their transformation was also discussed. Vanadyl porphyrins were initially separated and purified from atmospheric residue of two typical heavy oils, Canadian oil sand bitumen (OSAR), and Chinese Liaohe heavy oil (LHAR) by silica gel chromatography. The obtained vanadyl porphyrins were thermally treated for various reaction times under different hydrogen pressures with or without sulfur. The structures of these vanadyl porphyrins before and after thermal process were characterized by positive-ion Electrospray Ionization (ESI) Fourier Transform-Ion Cyclotron Resonance Spectrometry (FT-ICR MS). N_4VO, N_4VO_2, and N_4VOS were all identified as protonated analyte ($[M+H]^+$). Transformation of these vanadyl porphyrins were probed by analyzing the DBE distribution and carbon number distribution. Results showed that the three vanadyl porphyrins species showed different transformation reactivities. Increase of hydrogen pressure and addition of sulfur could promote the hydrogenation of vanadyl porphyrins. This indicates that different thermal reaction conditions should be chosen for hydrogenation and demetallization of different vanadyl porphyrins.

Biography

Zongxian Wang has completed his PhD from China University of Petroleum and Post-doctoral studies from National Research Council of Canada (NRC). He is now the Professor at China University of Petroleum (East China), and has published more than 60 papers in reputed journals.

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