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Ateyya A. Aboul-Enein, Ahmed E. Awadallah

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Production of nanostructured carbon materials using Fe-Mo/MgO catalysts via mild catalytic pyrolysis of polyethylene waste

Ateyya A. Aboul-Enein [a,b], Ahmed E. Awadallah [a,b,*]

[a] Process Development Division, Egyptian Petroleum Research Institute, Nasr City, PO Box 11727, Cairo, Egypt.

[b] EPRI-Nanotechnology Center, Egyptian Petroleum Research Institute, Nasr City, PO Box 11727, Cairo, Egypt.

* Corresponding Author E-mails: ahmedelsayed_epri@yahoo.com, awadallah@epri.sci.eg.

Abstract

A series of MgO supported bimetallic Fe-Mo catalysts with various Fe:Mo weight ratios (such as 50:0, 45:5, 40:10, 30:20, 20:30 and 10:40, respectively) have been prepared and evaluated for production of carbon nanomaterials (CNMs) via catalytic pyrolysis of low-density polyethylene (LDPE) plastic waste. Highly acidic ZSM-5 zeolite was used as a degradation catalyst during the pyrolysis process. To investigate the structure and physicochemical properties of the fresh catalysts, several characterization tools such as XRD, TPD, BET, TPR, and FTIR were employed. While to clarify the nature and morphology of as-produced CNMs, the spent catalysts were characterized by XRD, TEM, Raman spectroscopy and TPO. The XRD and TPR results confirmed that the non-interacted metal oxides species were dominant in the structure of the catalysts with higher Fe_2O_3 or MoO_3 contents, whereas several mixed oxide species were extensively present in the catalysts with moderate Fe_2O_3 and MoO_3 contents. The obtained results revealed that the Fe/Mo ratio was found to play a crucial role on the catalytic growth activity as well as the type and morphology of as-deposited CNMs. All results showed that the type and morphology structure of carbon deposited can be adjusted by changing the Fe/Mo ratio in the MgO support. The activities of