Chapter 7
Green-Synthesized Nanocomposites for Sustainable Fuel Desulfurization: Advances and Challenges

Abdullah Ozkan
https://orcid.org/0000-0002-6799-2396
Iskenderun Technical University, Turkey

Vildan Ozkan
https://orcid.org/0000-0001-8719-9099
Iskenderun Technical University, Turkey

Pinar Bozbeyoglu
Biomedical Device Technology Program, Electronics and Automation Department, Gümüşhane University, Turkey

Elif Esra Altuner
https://orcid.org/0000-0001-7663-6898
Kocaeli Health and Tecnology University, Turkey

ABSTRACT

The mounting global demand for energy signifies that we must depend on fossil fuels, which engenders environmental degradation and precipitates the emission of substantial quantities of sulfur oxides (SOx). Protecting themselves from environmental pollution is a top priority for many countries. Proper removal of sulfur-containing compounds from fossil fuels is becoming a major focus. Fuels such as diesel, fuel

DOI: 10.4018/979-8-3373-5966-3.ch007

oil, and gasoline are particularly important in this regard. Fuels such as diesel, fuel oil, and gasoline are particularly important in this regard. The numerous negative consequences of traditional hydrodesulfurization (HDS) methods are what researchers focus on, and these methods are limited. Some examples of these negative effects include higher costs, the use of too much pressure and temperature, and using too much hydrogen. Scientific studies show that biosourced nanocomposite materials are good for desulfurization methods because they can reduce the potential negative consequences. Using raw materials such as microorganisms, biopolymers, and plant extracts is one of the most important ways to increase energy efficiency and eliminate chemical emissions. The large surface areas, enhanced active site homogeneity, and diverse functional groups of nanocomposite materials obtained from such biosourced raw materials make them promising candidates for use in adsorptive and oxidative desulfurization processes. Metal-metal oxide (Fe, Ni, Cu, TiO_2) and carbon-based (graphene, carbon nanotube, and biochar-supported) nanocomposites are particularly preferred for achieving high sulfur removal with low energy consumption. The provision of information on the production methods, chemical properties, sulfur removal methods, and recent scientific research on biosourced nanocomposites is the purpose of this section. In addition, the environmental benefits, economic benefits, and potential roles of biosourced materials in alternative energy systems are discussed.

ABBREVIATIONS

Table 1 summarizes the abbreviations and acronyms used throughout this chapter for ease of reference.

Table 1. List of abbreviations.

Abbreviation	Full Form	Description / Equivalent Term
HDS	Hydrodesulfurization	Conventional catalytic desulfurization using hydrogen under high temperature and pressure
ODS	Oxidative Desulfurization	Oxidation-based sulfur removal using mild oxidants and catalysts
PDS	Photocatalytic Desulfurization	Light-driven oxidative desulfurization employing photocatalysts
ADS	Adsorptive Desulfurization	Sulfur removal through physical or chemisorptive interaction on porous materials

continued on following page