UNIVERSITY BABEȘ-BOLYAI
Faculty of Chemistry and Chemical Engineering

Versatile catalytic materials for oxidation reactions

HABILITATION THESIS

Dr. Mihaela Florea

Cluj, 2020

Abstract

The habilitation thesis presents the main results obtained by the author since her PhD thesis in 2003 in Chemistry, at Faculty of Biological, Agronomical and Environmental Engineering, Universite Catolique de Louvain la Neuve, Belgium. The overall subject of the thesis is built upon catalytic oxidation reactions which are among the most studied reactions in heterogeneous catalysis field and contribute ~30% of the total production in the chemical industry. Development of highly effective catalysts, such as versatile mixed oxides, is critical to promote research of a process, and much effort is required to achieve proper materials. Compared to catalysis on metals, catalysis using oxides has had a slower progress, due to more complex relationship between catalyst structure and the catalytic properties. However, this field has exponentially grown in the last years, and the most representative results of the author on this topic are highlighted throughout this thesis.

The dissertation is organized into two sections:

Section A deals with the original contributions of the author towards development of versatile heterogenous mixed oxides-based catalysts for oxidation reactions. This section is structured in two main parts:

- the first part aims to provide a concise and representative overview of developments in the field of **catalytic selective oxidation reactions**. In particular, it deals with the study of several catalytic materials used to prepare important types of compounds resulted by selective oxidation reactions. It includes two main sections: *i)* one discussing the efforts to develop new routes for production of added value chemicals by heterogenous catalytic selective oxidation reactions and *ii)* the second reviewing the energy generation ways through mixed oxides-based catalytic selective oxidation reactions. The studies provide an insight over the relationship between the physico-chemical catalyst properties and the catalytic performance.
- the second part begins with a justification and introduction regarding **total oxidation reactions**, particularly useful for depollution and environmental issues. Further, several types of heterogenous catalysts employed for volatile organic compounds (VOC) abatement are presented. In addition, this part provides a comprehensive review concerning developments of VOCs catalytic oxidation in presence of different mixed oxides, i.e. perovskites-based materials, ferrite-type based catalysts.

Moreover, this section highlights the developments gathered to understand and design new oxide based heterogeneous catalysts for total and selective oxidation reaction over the last two decades. It addresses in detail how the catalytic performance is affected by the physico-chemical properties of the catalytic materials and the reaction conditions.

Section B of this thesis describes the scientific, professional and academic future plans for the author career development on short and medium term, focusing on two main directions: (i) research activities and (ii) educational activities. The research activities include the perspectives of the author in the field **of catalytic selective reactions using non-oxides materials**. Two main ideas concerning the development of new types of non-oxide-based materials, as heterogeneous catalysts and the achievement of high conversions and selectivities for different selective catalytic reactions, are highlighted.