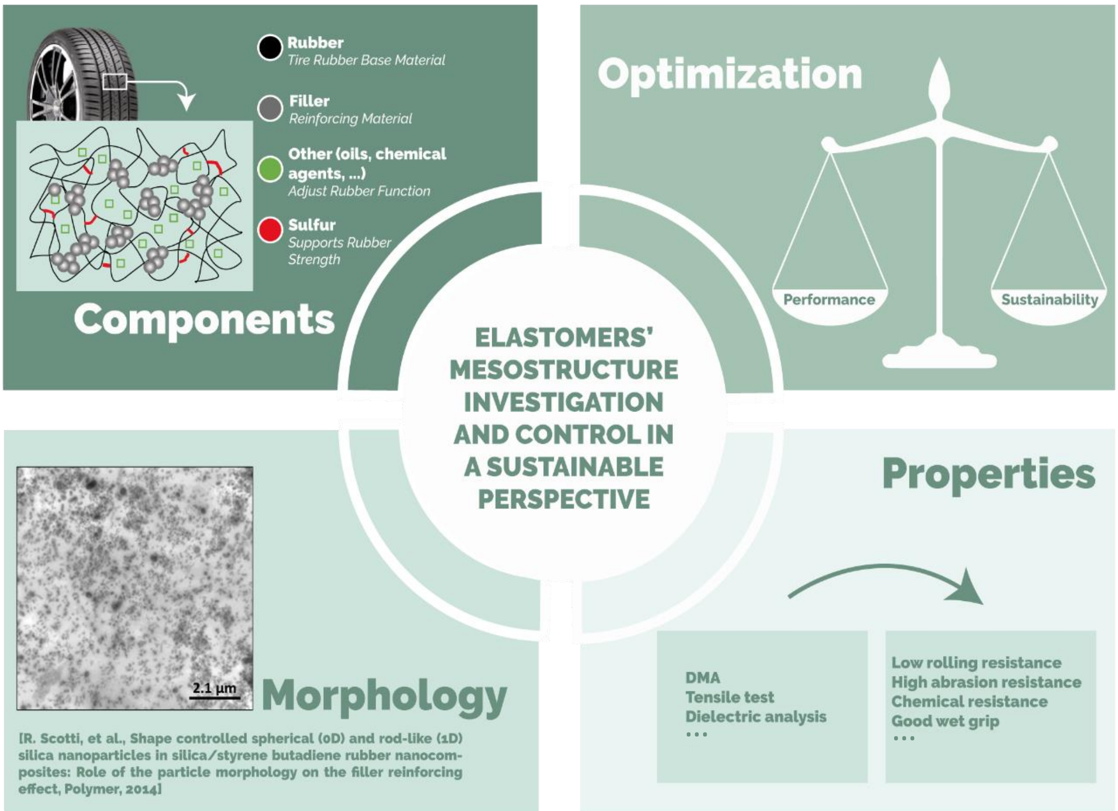
ELASTOMERS' MESOSTRUCTURE INVESTIGATION AND CONTROL IN A SUSTAINABLE PERSPECTIVE

Gioacchino Pignatiello – Advisor: Prof. Giovanni Filippone

Curriculum: Ingegneria dei Materiali e delle Strutture

The performance of technical rubber items, particularly tires, strongly depends on the interaction among the components of the elastomeric compounds. These complex multiphase systems are made up of mixtures of natural and/or synthetic rubbers with reinforcing fillers, stabilizers, processing aids, and chemical agents for vulcanization. Since the last century, the tire industry has focused on developing new materials and technologies to ensure end users' safety across various tire applications, including passenger cars, trucks, buses, and motorcycles. Over the past decade, the future of tire technology has observed new horizons, looking not only at performances related to safety parameters, such as dry and wet grip, but also at environmental aspects. The introduction of parameters that consider environmental aspects has marked an important change in the approach of tire companies in developing new products. To address environmental concerns and reduce reliance on fossil fuels, the incorporation of bio-based components in tire manufacturing is gaining increasing attention. Unfortunately, integrating bio-based components in an inherently complex mixture of many components is not straightforward due to the complex physical and chemical interactions that establish among the phases. A comprehensive understanding of compatibility, processing requirements, and potential interactions with other components is essential for achieving effective dispersion within rubber matrices.



In this project, a series of rubber compounds for tires containing biobased components will be studied, focusing on the processability and performance of the various formulations. In particular, compounds containing different petroleum-based and bio-based resins will be compared. Changing even a single component affects the processing parameters, such as torque and mixing temperature, and the rheological fingerprint of the compound. This implies complex relationships among formulation, mixing procedure, and final performance. Life Cycle Assessment methodology will support the formulation for investigating the actual sustainability of the selected green additives. Information about the system morphology and microstructure will be collected using Transmission Electron Microscopy (TEM) and dielectric analysis. The results will be correlated to mechanical and viscoelastic properties analyzed with tensile tests conducted at different temperatures and Dynamic-Mechanical Analysis (DMA).

Gioacchino Pignatiello, PhD student XXXVIII cycle, May 2023

gioacchino.pignatiello@unina.it