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UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA

MUR

Scienza dei Materiali Materials Science and Nanotechnology	
Progetto di ricerca/ Research project	*"Rubber Nanocomposites: aging and stabilization"* ***MAT.1***
Tipo/Type	Borsa finanziata da ente esterno / Scholarship funded by external body CORIMAV
Borse/Scholarships	1
Abstract	**ENG** The phenomenon of rubber aging is due to several factors, including environmental conditions such as heat, oxygen, light, humidity, pollution, microorganism. For this, anti-aging additives are commonly used in rubber composites, to improve their performance, prevent or delay the degradation processes and extend the service life of materials. In particular, tyre formulations involve aminic or phenolic chemical antioxidants-derived on the non-renewable fossil sources with a consequent environmental impact, also due to the highly toxic transformation products of the additives. In this contest, the present PhD project focuses on aging and stabilization processes of rubber nanocomposites. In particular the research activity aims: i) to analyze the mechanism related to oxidation process that affects rubber materials as well as anti-oxidation processes of anti-aging agents; ii) to investigate promising routes for developing high performance rubber additives taking into consideration nanoparticle antioxidants, such as metal oxides, or filler-supported additives, where antioxidant molecules are chemically immobilized on the surface of fillers, such as silica, alumina or graphene oxide.
Specific IPR rules: Intellectual property clauses agreed with the Company apply to this scholarship	

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Scienza e Nanotecnologia dei Materiali Materials Science and Nanotechnology	
Progetto di ricerca/ Research project	*"Lignin-based materials as sustainable functional fillers for elastomeric compounds"* ***MAT.2***
Tipo/Type	Borsa finanziata da ente esterno / Scholarship funded by external body CORIMAV
Borse/Scholarships	1
Abstract	**ENG** A fundamental pillar of Sustainability is the use of Renewable Resources from biomass to generate materials suitable for each and every technical application, e.g. through a "biorefinery" approach aiming to substitute oil-derived materials. Lignin is one of the three main components of lignocellulosic materials and it is the most abundant aromatic biopolymer on the planet. However, its intrinsic complexity (generated either by the botanical origin either by the isolation process) and polarity limits its potential use in compounds based on low polarity polymers such as elastomeric compounds used in tire technology: the mechanical properties of natural rubber reinforced with lignin were often found to be limited by the non-optimal interactions between the biopolymers. The target of this research is to investigate innovative ways to obtain lignin-based materials tailored for rubber compounds, exploiting preferably water-borne functionalization processes. The principles of synthetic green chemistry will lead the development of such materials, promoting the transition of the tire industry towards a massive utilization of biomaterials The activity will include laboratory synthetic work to obtain the desired materials from Biomass, compounding activity to formulate compounds with such materials and full characterization of the lignin derivatives and of the corresponding compounds.
Specific IPR rules: Intellectual property clauses agreed with the Company apply to this scholarship	

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Scienza e Nanotecnologia dei Materiali Materials Science and Nanotechnology	
Progetto di ricerca/ Research project	*"Enhancing the thermal conductivity of rubber composites by using modified or hybrid fillers"* ***MAT.3***
Tipo/Type	Borsa finanziata da ente esterno / Scholarship funded by external body CORIMAV
Borse/Scholarships	1
Abstract	**ENG** Rubber has an intrinsically low thermal conductivity, which limits its potential when fast and effective heat dissipation is desired, like in strategic materials such as rubber composites for tires. The addition of high loadings of thermally conductive fillers, i.e. graphite, carbon black, carbon fibers, ceramic or metal particles is typically employed to increase the thermal conductivity, although dramatically altering the mechanical behavior and the cross-linking density of the final materials. To overcome these drawbacks several endeavors have been recently devoted to the surface functionalization of commercially available materials and to the design of anisotropic fillers able to impart both high thermal conductivity and satisfactory mechanical performances, allowing also to reduce the filler loading. Along this line, the present PhD project aims at developing innovative synthesis or modification strategies which improve both filler aspect ratio and interfacial adhesion with the rubber matrix, with the ambitious goal of boosting the generation of effective thermally conductive pathways. Moreover, hybrid fillers will be designed, in order to "take the best" both from the features of carbon-based materials (i.e. highly thermal and electrical conductivity) and inorganic ones (morphology modulation, high packing density, reinforcing ability), to optimize the final composites performance Investigation on nanoparticles structure, morphology and final composites thermomechanical properties will be conducted and the best formulation will be possibly scaled up for application in tyres.
Specific IPR rules: Intellectual property clauses agreed with the Company apply to this scholarship	