Description of Funded Research Projects
1st Call for H.F.R.I. Research Projects to support Post-Doctoral Researchers

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Research Project Title:

Dynamics of SPREADing on liquid substrates with complex rheology

Principal Investigator:
George Karapetsas

Popular Title:

Spreading of liquid droplets on liquid substrates with complex rheology

Scientific Field:
Engineering and Technological Sciences

Host Institution:
Aristotle University of Thessaloniki

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The aim of our work is to provide fundamental understanding on the dynamics of liquids spreading on soft materials with complex rheological behavior, a problem that lies at the heart of many engineering, biological and biomedical settings. Emphasis is placed on the drug delivery on compliant substrates, which involves spreading of bioadhesive or muco-adhesive liquids over tissue or over mucus laden films in the lung or elsewhere in the body. In lung diseases such as cystic fibrosis and chronic obstructive pulmonary disease the efficacy of the administered drugs is often limited by heterogeneous distribution and non-uniform deposition. To improve dose uniformity, it is crucial to find ways in order to maximize post-deposition spreading of the liquid drug on the airway lining (e.g. with efficient use of surfactants). The latter, however, consists of a mucus layer with rather complex rheology, typically exhibiting both considerable yield stress and viscoelastic properties. The mechanisms that affect the spreading process on these complex systems, however, are very poorly understood, and this lack of understanding considerably hinders the development of more efficient drugs.

This project aims to perform an in-depth study of these systems in order to elucidate the mechanisms that affect the spreading process and how they depend on the rheological properties of the compliant substrate. This will be achieved through the development of detailed theoretical models, fully taking into account the complex nature of these materials. Carefully designed experiments will also be performed to provide the appropriate validation for the developed models. Our aim is, through a balanced program of computational analysis and experimentation, first to identify what mechanisms may either inhibit or promote spreading and second to investigate novel ways to harness the spreading process to our benefit.

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Project Impact on Society

The ultimate goal of the proposed research project is to be able to provide novel ways and guidelines for improving the efficacy of drugs used in common lung diseases such as cystic fibrosis and chronic obstructive pulmonary disease by maximizing post-deposition spreading. An in depth understanding of the fundamental physical mechanisms which govern liquid spreading over compliant substrates and the development of novel robust validated computational tools, can result in considerably reduced costs and time for the design, development and optimization of novel drugs, and therefore the proposed research will be of great interest to the pharmaceutical sector.

The societal impacts of the proposed project are also expected to be significant since the development of more efficient drugs is crucial in order to considerably improve both the quality of life of these patients as well as their life expectancy.

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To me, H.F.R.I. funding would mean...

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Funding from H.F.R.I. provides the necessary support in my early academic steps to build a research group and work on a very interesting topic. I will always be grateful to H.F.R.I. for giving me this great opportunity that will help to launch my academic career.

The Principal Investigator,
George Karapetsas

Funding

Amount: **180,000 €**

Duration: **36 months**

Foundation: **H.F.R.I.**

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Hellenic Foundation for Research & Innovation

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