

# DELIVERABLE

## D4.4

### Annual Report on the progress of PhD Thesis



**Grant Agreement number: 642861**

Project acronym: BioSmartTrainee

Project title: Training in Bio-Inspired Design of Smart Adhesive Materials

Funding Scheme: MSCA-ITN-2014-ETN

Project coordinator name: Dr. Alla Synytska

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Project coordinator organization name: Leibniz-Institut für Polymerforschung Dresden e.V.

Project website address: [www.biosmartrainee.eu](http://www.biosmartrainee.eu)

Related to a reporting period: RP 1

Milestone no./name: -

Lead beneficiary: WU

Nature: Report

Dissemination Level: public

Delivery date from Annex I: month 12 (September 2016)

As of month 12 of the project all partners successfully recruited a PhD student (ESR) and all PhD students (ESRs) started their project.

Individual progress of ESRs :

<b>ESR 1</b>	
Name fellow:	Marjolein Sliepen
Name supervisor:	Dr. Alla Synytska
Host institute:	Leibniz-Institut für Polymerforschung Dresden e.V. (Functional Particles and Interfaces Group), Germany
Progress	Since 01.08.2016
ESR project: Responsive polymeric surfaces with controllable underwater adhesion properties	
<p>During the first weeks at the Leibniz-Institut für Polymerforschung Dresden e.V., Marjolein mainly caught up on the topic and studied literature on bioinspired materials and adhesion phenomena in wet environments, synthesis of polymers via atomic transfer radical polymerization (ATRP), and catechol chemistry. She performed successfully several syntheses and got trained in the polymerization of several polymeric brush systems. She has already learned how to synthesize SiO<sub>2</sub> particles using the Stöber method, and has synthesized SiO<sub>2</sub> particles with diameters of 50, 100, and 200 nm. Marjolein also learned several analytical tools such as null ellipsometry, wetting via contact angle measurements, dynamic light scattering (DLS) and scanning electron microscopy (SEM).</p>	

<b>ESR 2</b>	
Name fellow:	Maria Villiou
Name supervisor:	Prof. Dr. Aranzazu del Campo
Host institute:	Leibniz-Institut für Neue Materialien gGmbH, Saarbrücken, Germany
Progress	Since 15.08.2016
ESR project: Bioinspired medical adhesives	
<p>Maria has initiated her literature search and reading in catechol functionalized hydrogels, as bioinspired materials for attachment in wet environments, i.e. tissue attachment. She has initiated her practical training in organic synthesis of catechol related compounds. Maria has worked in standard procedures for the conversion and (de)protection of catechol bearing molecules and in purification techniques (silica gel column chromatography, analytic and preparative HPLC) and characterization of small organic compounds (NMR, MS). The results have been very satisfactory.</p>	

<b>ESR 3</b>	
Name fellow:	Marco Dompé
Name supervisor:	Dr. Marleen Kamperman
Host institute:	Wageningen University, The Netherlands
Progress	Since 11.01.2016
ESR project: Bioinspired underwater adhesives using complex coacervation	
<p>The goal of the project is to use complex coacervation between hydrophobically modified polyelectrolytes in order to obtain strong and tough material suitable for underwater adhesion. After spending the first weeks looking into literature, Marco has been introduced to the polymer synthesis and has successfully synthesized the negatively charged copolymer. He is now working on the complete synthesis of the cationic copolymer and on the</p>	

optimization of the synthesis protocol. In the close future he will try to synthesize other polyelectrolytes with different hydrophobic domains. He has also been introduced to lab techniques (such as rheology, DLS, NMR, FTIR, GPC) which are needed to characterize the developed materials. Marco has also successfully obtained a certificate for the “Polymer Chemistry” course organized by RPK in Utrecht.

<b>ESR 4</b>	
Name fellow:	Francisco Javier Cedano Serrano
Name supervisor:	Dr. Costantino Creton
Host institute:	CNRS/ESPCI, Paris, France
Progress	Since 01.04.2016
ESR Project: Underwater adhesion between model gels and functionalized surfaces: from molecular interactions to macroscopic adhesion	
The training in the use of laboratories and equipment is complete. Francisco already knows how to prepare hydrogels, modified surfaces and conduct underwater adhesion tests. The first experimental design was designed and has been started at this stage of the project.	

<b>ESR 5</b>	
Name fellow:	Mehdi Vahdati
Name supervisor:	Dr. Costantino Creton
Host institute:	CNRS/ESPCI, Paris, France
Progress	Since 12.09.2016
ESR project: Adhesive properties of injectable hydrogels	
The aim of this project is to synthesize and characterize graft copolymers from PDMA as the backbone and PNIPAM or PEGMA as the stickers. Then temperature induced sol-gel transition (from solutions in water to hydrogels) will be studied in physiological conditions. The final goal is to determine their mucoadhesive properties. We have just started the project and it is at the early stage of material choice, design, and synthesis.	

<b>ESR 6</b>	
Name fellow:	Vaishali Chopra
Name supervisor:	Dr. René Hensel
Host institute:	Leibniz-Institut für Neue Materialien gGmbH, Saarbrücken, Germany
Progress	Since 01.05.2016
ESR project: Adhesion of bioinspired micropatterned adhesives on soft substrates	
Vaishali started to study the fundamentals of adhesion, bio-inspired adhesion and electro-adhesion through literature survey and participation in conferences.	

<b>ESR 7</b>	
Name fellow:	Justine Tavera
Name supervisor:	Dr. Matthias Gerst
Host institute:	BASF SE, Ludwigshafen / Saarland University
Progress	Since 18.04.2016
ESR project: Functional Polymers and Latex particles for improved adhesion on fouled surfaces	
The project is now focusing on the synthesis of polyampholyte polymers in water-borne	

dispersions for improving the performances of pressure-sensitive adhesives. Justine has made progress in the understanding of the parameters that govern the stability and viability of these dispersions.

Justine is supervised by Prof. Del Campo at INM in Saarbruecken (University of Saarland), from where she will get the PhD. After discussion with Mrs. Del Campo, it will be able for Justine to present important and relevant results during their department meetings. Justine will regularly keep contact to let Prof. Del Campo know what the progress of the made project is, how the project will mature and she gets her opinion, advices on the situation.

### **ESR 8**

Name fellow:	Ki Woong (Victor) Kang
Name supervisor:	Prof. Walter Federle
Host institute:	Cambridge University, UK
Progress	Since 01.09.2016
ESR project: Biomechanics of animal adhesion in wet environments	
Victor has only just started his PhD thesis. He has read about the background of the project, and is currently setting up the first experiments.	

### **ESR 9**

Name fellow:	Maciej K. Chudak
Name supervisor:	Prof. Anton Darhuber
Host institute:	Technical University Eindhoven, The Netherlands
Progress	Since 01.12.2015
ESR project: The physics of adhesion to wet and icy surfaces	
The TU/e group has developed an interferometry-based experimental setup for studying liquid squeeze-out flow and solid-liquid-solid dewetting between an elastomeric sphere and a flat substrate including force control. Moreover, the TU/e group is currently working on developing a surface-plasmon-resonance based experimental setup which promises to provide a higher resolution for layer thickness measurements in the nm range.	

<b>ESR 10</b>	
Name fellow:	Dimitris Mintis
Name supervisor:	Prof. Vlasis Mavrantzas
Host institute:	University of Patras, Greece
Progress	Since 01.06.2016
ESR project: Molecular modelling and simulation of polymers and polypeptides with controllable and adaptive adhesion properties in wet environments	
<ul style="list-style-type: none"> <li>• Advanced theoretical background has been developed around the field of statistical mechanics and computational modelling</li> <li>• Effective utilisation of computer systems and software has been taught in the design of several simulation methods such as Molecular Dynamics method and Monte Carlo</li> <li>• Extensive research has been performed around the following topics: Polymer science, synthetic polyelectrolyte complexes (in particular) Coacervation phase separation</li> <li>• First simulation has been performed, by implementing the Molecular Dynamics method, for exploring the effect of pH on the structure of a polyelectrolyte in aqueous solution</li> </ul>	
Skills developed:	
<ul style="list-style-type: none"> <li>• Justifying research methods</li> <li>• Understanding academic exploitation</li> <li>• Critical thinking</li> <li>• Recognizing research problems</li> </ul>	
Currently we are designing Molecular Dynamic and Monte Carlo methods to best illustrate chain self-organization and morphology of synthetic polyelectrolytes and polypeptides in aqueous solution.	

<b>ESR 11</b>	
Name fellow:	Aurélie Feat
Name supervisor:	Phil Taylor
Host institute:	Imperial Chemical Industries Limited, ICI, UK
Progress	Since 12.09.2016
ESR project: Advanced adhesion paints	
Project starts on 12 <sup>th</sup> September 2016 and first tasks will be training in laboratory safety and procedures, drawing up a Career Development Plan and training in decorative latex and decorative paint making and testing, focusing on adhesion testing	
Aurelie will get her PhD from Wageningen University (WU), sponsored by Professor Jasper van der Gucht (WU). There will be monthly telephone calls between Aurélie Feat, Dr. Philip Taylor (ICI) and Professor Jasper van der Gucht (WU), and quarterly Face-To-Face meetings.	