**Project title**: Stents with self-expandable structures from biodegradable and traceable shape memory polymers

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**Function**: Assistant Professor Biobased Materials

**Collaborators**: Prof. Stefan Jockenhövel

**Proposal (250 words):**

**Introduction**:
Stents are largely used in surgical procedures to maintain the patency of an artery. Commercial stents are often made of metal which is very stiff (damages vessels) and which has many limitations that can lead to blood clots and restenosis (re-narrowing of the artery). Biodegradable polymeric stents that degrade over time in the body are potential solutions. Often shape memory polymers are used, which are delivered in a compact form via minimally invasive surgeries in humans, and which can be deployed to achieve complex final (expanded) shapes. A poly-L-lactic acid (PLA) stent with a self-expandable property exists, but the sent shows disadvantages like vessel injury during deployment and acidic degradation products giving inflammation.

**Hypothesis and Objectives**:
The purpose of the present study is to design and prepare a biodegradable and multifunctional shape memory material for stents which outperforms PLA. Additionally, the stent design allows controlled drug release and traceability upon in vivo implantation in order to allow feedback on the stent material over time.

**Setting and Methods**:
Thermo-responsive shape memory polymers based on poly(1,4-dioxan-2-one) (PDX) copolymers and water expandable shape memory materials based on chitosan will be synthesized. The copolymer composition and structure will be modified in order to tune the stent properties like mechanical properties, triggering/fixing condition, degree of fixing/recovery, biocompatibility/biodegradability, drug-eluting kinetics, traceability and many other aspects.

**Impact**:
The global biodegradable stents market is forecast to reach 3.5 million units by 2020, driven by the high prevalence of artery diseases among the rapidly aging world population.

**Requirements candidate**: Highly motivated student with good English communication skills and proactive and resolute attitude. Chemistry fields: polymer synthesis, chemical and physical characterization of monomers/polymers, biomedical materials.

**Keywords**: stent, shape memory polymer, smart polymers, biobased polymer, biodegradable, traceable, biomedical materials

**Top 5 selected publications:**

1. Weinandy S, Rongen L, Schreiber F, Cornelissen C, Flanagan TC, Mahnken A, Gries T, Schmitz-Rode T, **Jockenhoevel S**. The BioStent: Novel Concept for a Viable Stent Structure, Tissue Engineering, Part A 2012; 18(17-18), 1818-1826 [IF 3.485]

2. Lammers T, Mertens ME, Schuster P, Rahimi K, Shi Y, Schulz V, Kuehne AJC, **Jockenhoevel S**, Kiessling F. Fluorinated Polyurethane Scaffolds for $^{19}F$ Magnetic Resonance Imaging, Chemistry of Materials 2017; 29(7), 2669-2671 [IF 9.466]

3. Delgove MAF, Luchies J, Wauters I, Deroover GGP, De Wildeman SMA and **Bernaerts KV**. Increasing the solubility range of polyesters by tuning their microstructure with comonomers. Polymer Chemistry 2017; 8:4696-4706 [IF 5.375]

4. Wroblewska AA, Lingier S, Noordijk J, Du Prez FE, De Wildeman SMA, **Bernaerts KV**. Polyamides based on a partially bio-based spirodiamine. European Polymer Journal 2017; 96, 221-231 [IF 3.531]

5. Wróblewska AA, **Bernaerts KV**, De Wildeman SMA. Rigid, bio-based polyamides from galactaric acid derivatives with elevated glass transition temperatures and their characterization, Polymer 2017; 124:252-262 [IF 3.684]