Green Chemistry TechHub – A Trilateral Doctoral Program

The Green Chemistry TechHub is a joint doctoral training program established by TU Wien (TUW), the University of Natural Resources and Life Sciences (BOKU), and the University of Vienna (UV). Funded by the Austrian Research Promotion Agency (FFG) and supported by a robust network of industry partners, the program is dedicated to advancing innovation in sustainable and environmentally responsible chemistry through interdisciplinary research and academic–industry collaboration.

We are currently offering 8 fully-funded PhD positions across the three institutions:

- 4 Positions at TU Wien (TUW)
- 2 Positions at BOKU University (BOKU)
- 2 Positions at University of Vienna (UV)

Each doctoral researcher will engage in a four-year research program, spending **up to 3 years at the academic institution** and **1 year embedded with an industry partner or continued employment at the academic institution with a secondment placement at industry**, gaining valuable cross-sector experience in applied green chemistry and biotechnology. The positions are equivalent to part-time university assistantships (30 hours/week) and offer competitive remuneration according to FFG guidelines and the respective university's pay scale, including full social benefits.

We offer:

- An interdisciplinary, applied research setting within the **Green Chemistry TechHub**
- Exposure to both academic excellence and real-world industrial challenges
- Hands-on experience with advanced tools and methodologies in sustainable biotechnology
- Competitive funding and access to professional development resources
- Diverse and cutting-edge research projects
- Continuing personal and professional education
- Additional optional training as a Green Chemistry Change Manager (GCCM)
- High-quality supervision by renowned scientists
- Ample opportunities for international networking, secondments, and research collaboration
- Courses on transferable skills
- Comprehensive social benefits (e.g., health insurance)
- Administrative support in study and organizational questions
- A central location in Vienna—consistently ranked as the city with the best quality of life
- A dynamic and inclusive working environment

Applications:

Application Process: Applications will be reviewed on a rolling basis until the position is filled.

At the Green Chemistry TechHub consortium we are committed to equal opportunity and strive to increase the representation of women within scientific staff across all partner institutions. Therefore, we strongly encourage qualified women to apply. Female applicants will be given preferential consideration when their qualifications, aptitude, and professional performance are comparable to those of male applicants. Additionally, persons with disabilities are especially encouraged to apply.

Applications should be submitted online via the TU Wien job portal.

Required Documents:

- A **cover letter** listing three preferred PhD topics from the project list (ranked with motivation)
- A **curriculum vitae**, including publications, conference contributions, and other scientific activities (if applicable), preferably using the Europass template
- A **one-page summary** of the diploma/master's thesis
- **Transcripts** of records of the Bachelor- and Master-studies
- A **one-page outline** on how you would approach the proposed project

Selection Process:

Shortlisted candidates will be invited to participate in a **video or face-to-face hearings**, which will include:

- A presentation on previous research projects
- A short discussion of a thematically related publication (article sent one week in advance)
- A critical reflection on the proposed implementation of the selected project

This multi-stage process ensures a comprehensive evaluation of technical expertise, strategic thinking, and alignment with project objectives.

For further information about the open positions or the application procedure, please contact the Project Manager, Muhammad Farooq Zia (muhammad.zia@tuwien.ac.at), or reach out to one of the project leaders.

Positions (English):

Position 1. Biotechnological methanol valorization (BOKU/New Path Bio)
Position 2. Production of biochemicals based on biodiesel and bioethanol waste (BOKU/Vogelbusch)
Position 3. Membrane separation process for CO_2 (TUW/VOESTalpine)
Position 4. Sustainable polymer processing (UV/BASF)
Position 5. Starch modification (TUW/Agrana)
Position 6. Sustainable isotope labeling (UV/Boehringer Ingelheim)
Position 7. Solvent-free reaction cascades using mechanochemistry (TUW/RDP)
Position 8: Development of a modular polysaccharide platform using click chemistry (TUW/Agrana)

Positions (German):

Position 1: Biotechnologische Methanol Valorisierung (BOKU/New Path Bio)
Position 2: Lentilactobacillus Plattform (BOKU/Vogelbusch)
Position 3: Membranseparationsprozess für CO_2 (TUW/VOESTalpine)
Position 4: Nachhaltige Polymer-Prozessierung (UV/BASF)
Position 5: Stärkemodifikation (TUW/Agrana)
Position 6: Nachhaltiges Isotopenlabelling (UV/Boehringer Ingelheim)
Position 7: Lösungsmittelfreie Reaktionskaskaden mittels Mechanochemie (TUW/RDP)
Position 8: Modulare Polysaccharid-Platform mittels Click Chemie (TUW/Agrana)

Position 5:

Starch based water resistant glues via diazirine mediated covalent bonding

The challenge: Lack of water resistance and insufficient interaction with low energy surfaces.

Starch has been used as binder for glues both in natural and modified form since centuries. However, to date, some limitations exist. First, while being excellent glues on polar and porous substrates such as paper and wood under dry conditions, due to the hydrophilic nature of starch and its ability to swell in water, wet-resistance is an unmet challenge limiting areas of application. Second, polar starch-based adhesives do not very well interact with low energy surfaces like plastics. Thus, the desirable use of abundantly available renewable resource starch for modern adhesive is strongly restricted.

Our envisioned solution: Covalent binding of starch to surfaces based on diazirine activation.

Within our research project we want to tackle and overcome both of these drawbacks in utilizing starch as a renewable component of future high performing adhesives. Towards this end, we want to investigate diazirine-activation chemistry, which allows the generation of reactive radicals by heat or light as stimulus leading to unselective and covalent binding to all types of surfaces including inactivated ones like PE or PP.

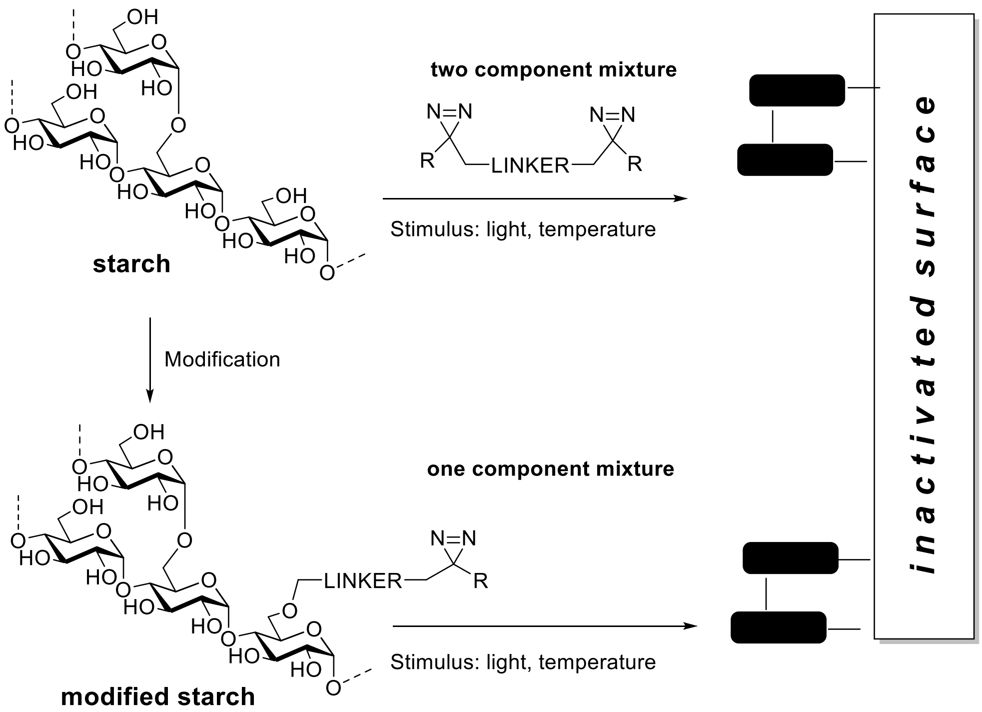

Figure 1: Envisioned two component approach by mixing starch glue with a linker prior to application versus per-modification of starch material for immediate use as adhesives upon activation with light (thin film) or heat (bulk material)

Diazirines as modern synthetic tools to generate connection: Diazirines are strained small heterocycles which upon activation by light or heat loose elemental nitrogen and generate reactive radicals that insert into activated and even non-activated CH bonds. This chemical strategy lay dormant for several decades but is heavily investigated in the last years and to date, diazirines are on the onset to become routine and well understood chemical tools.[1] A reasonable number of recent scientific reports covering differently tuned diazirines to link or crosslink polymers,[2] including low-energy polymers lacking any reactive handles like polyethylene are available and diazirines have also been used to connect different polymers to form composite materials.[3-5] There have been pioneering work on the use of diazirines in the context of biomaterials and tissue engineering and among other materials cellulose has already been successfully addressed with diazirine-activated linkers,[3-4] an important precedence for our planned work with starch.

Diazirines from amino acids: Noteworthy diazirine building blocks can be derived from different natural amino acids in a short synthetic route, allowing a high degree of variation starting from renewable substrates.[6]

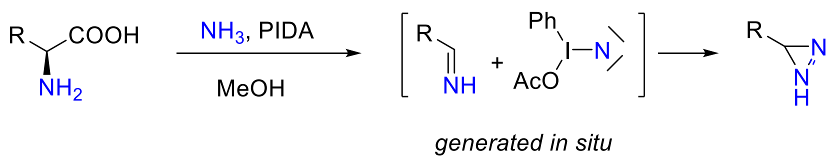

Figure 2: Direct diazirine synthesis from natural amino acids from literature report[6]

Our group has started working with diazirines in the context of protein-labelling in recent years, thus the preparation and activation of state of the art diazirine-precursors is fully established in our lab. We have also several years of experience in the modification of starch. We envision that for ambitious goals of this project, this pre-experience will proof valuable and to efficiently go beyond the state of the art in fine-tuning the diazirine structure towards reaching the goals of this project.

For the current PhD project, we envision to follow two different strategies towards the development of starch-based glues and diazirine containing components to succeed in strong covalent adhesion of starch glue to different surfaces and also to achieve increased water resistance in starch-based adhesives. (see Figure 1).

Approach A: Two component glues: First, we want to develop tailor-made components with two reactive handles to be used in mixtures with typical starch glues, in order to be activated upon application to trigger simultaneously covalent crosslinking of starch and linking to the surface.

Approach B: Modified starches as tools to study the interaction: In the second approach, starch will be modified with diazirine containing linker entities utilizing different standard attachment principles like epoxide opening or alkylation. This way, covalently linked diazirine-handles are attached to starch with a higher degree of control in respect to the exact composition of the material before it is activated with heat (>80 °C) or (UV) light) to form covalent bonds between the starch glue and the surface. This approach is more anticipated as a means to study structure activity relationships of the diazirine materials for the envisioned purpose.

Both approaches have pros and cons in terms of compatibility of chemistry to link linkers to starch and surfaces and in terms of stability of (premixed) combinations. Comparison of the two approaches with similar structures and the comparison of different linker and diazirine-substructures will be at the core of this PhD project. Noteworthy, in both approaches we will also pursue chemically more established methods for the formation of covalent bonds between modified starch materials as the thiol-ene reaction or classical click chemistry.[7-9] Those approaches are both intended as model reactions and also fall back strategy should the diazirine activation turn out to be not feasible.

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3. Singh, J.; Steele, T. W. J.; Lim, S., Fibrillated bacterial cellulose liquid carbene bioadhesives for mimicking and bonding oral cavity surfaces. *Journal of Materials Chemistry B* **2022,** *10* (14), 2570-2583.
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9. Li, Y.; Tan, Y.; Xu, K.; Lu, C.; Wang, P., A biodegradable starch hydrogel synthesized via thiol-ene click chemistry. *Polym. Degrad. Stab.* **2017,** *137*, 75-82.