The Laboratory:

Project A: Multi-step Synthesis of Coordination Networks Based on Redox-Active Ligands Badge: Master 1 | Chemistry

Objective: "To perform the total synthesis and purification of a complex functionalized alloxazine-based tecton for the self-assembly of porous coordination networks (MOFs). The challenge was to integrate redox-active motifs capable of modulating electron transfers within organized molecular architectures."

Methodology: * **Synthesis Engineering:** Execution of a four-step synthetic sequence: chemoselective reduction using NaBH4 (0°C), bifunctional catalysis-assisted double condensation (boric acid template effect), double N-alkylation, and a Palladium-catalyzed Suzuki-Miyaura cross-coupling.

- **Operational Mastery:** Manipulations under inert atmosphere (Argon) using a Schlenk line, reflux heating (100°C), and purification via silica gel column chromatography with dry loading.
- **Advanced Characterization:** Systematic structural elucidation of intermediates and the final ligand through 1H NMR spectroscopy (processed via MestReNova), Infrared (ATR), and UV-Visible.
- **Self-Assembly:** Engagement of the final tecton in solvothermal crystal growth with zinc salts to generate 3D coordination polymers.

Key Skills (Arsenal):

- Complex Organic Synthesis (Suzuki-Miyaura, Schlenk line)
- Advanced Characterization (NMR, IR, UV-Vis)
- Molecular Modeling & Analysis (MestReNova, ChemDraw)
- Coordination Chemistry (MOFs, Crystal Growth)

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Personal Growth & Insights: "This project forged my patience and surgical precision. Multi-step synthesis is a lesson in humility: I learned that an insignificant stoichiometric discrepancy (hydrated vs. anhydrous salt) can redefine the trajectory of an entire crystallization. I emerged with an enhanced ability to diagnose kinetic barriers and adapt my thermal strategies to bring a complex project to completion.

Project B: Alginate Hydrogels: Architecture of Controlled Release Badge: L3 | Biochemistry & Polymer Science

Objective: "To design and optimize biopolymer vectors (alginate beads) capable of encapsulating and releasing an active substance in a programmed manner. The challenge was to understand how the gel structure and the addition of additives influence diffusion kinetics."

Methodology:

- **Polymer Engineering:** Synthesis of hydrogel beads via ionic gelation (cross-linking of sodium alginate in a CaCl2 solution).
- **Hybrid Material Formulation:** Integration of activated carbon within the polymer matrix to increase adsorption capacity and delay the release of methylene blue.
- **Kinetic Study:** Real-time monitoring of release using UV-Visible spectrophotometry at different temperatures to model diffusion fluxes.
- **Data Analysis:** Correlation between physical parameters (temperature, carbon concentration) and the efficiency of the release system.

Key Skills (Arsenal):

- Polymer Chemistry (Gelation, Cross-linking)
- Formulation & Encapsulation
- Analytical Chemistry (UV-Vis Spectrophotometry)
- Kinetic Modeling (Diffusion Laws)

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Personal Growth & Insights: "This project was my first immersion into the chemistry of complex systems. I learned that chemistry is not limited to transforming molecules but also involves organizing matter in space. By adjusting the 'porosity' of my beads, I realized that the architect can dictate time: slowing down or speeding up a process invisible to the naked eye. It is proof that molecular design has a direct impact on environmental performance.

Voici la traduction en anglais pour ton **Projet C**, parfaitement alignée avec le style des précédents :

Project C: Inorganic Chemistry: Architecture of Solids & Ceramic Materials Badge: L3 | Materials Science

Objective: "To synthesize complex oxides with a spinel structure (NiAl2O4) using soft chemistry methods and to develop traditional ceramics. The challenge was to correlate heat treatment parameters (up to 1280°C) with the crystalline microstructure and the final properties of the material."

Methodology:

- **Sol-Gel Synthesis (Pechini):** Powder preparation via the citrate method to ensure atomic homogeneity and high phase purity.
- **Thermal Engineering:** Management of calcination and sintering cycles in high-temperature furnaces to induce crystallization and material densification.
- **Crystallographic Characterization:** Rigorous phase analysis by X-Ray Diffraction (XRD) and calculation of lattice parameters to verify Vegard’s Law.
- **Thermogravimetric Analysis (TGA):** Monitoring of physicochemical transformations and mass losses during temperature rise.

- **Industrial Ceramics:** Shaping of clay plates and study of their structural evolution (dehydration, dehydroxylation).

Key Skills (Arsenal):

- Inorganic Materials Science (Oxides, Spinels, Ceramics)
- Solid-State Synthesis (Sol-gel / Pechini, Sintering)
- X-Ray Diffraction (XRD) Analysis
- Thermal Analysis (TGA)

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Personal Growth & Insights: "This project allowed me to transition from isolated molecules to the three-dimensional organization of solid matter. I learned that temperature is an atomic 'sculpting' tool: by controlling heat, I could dictate the arrangement of ions within the crystal lattice. This rigor in controlling thermal cycles is, for me, the foundation of high-performance materials engineering.

Voici la traduction anglaise de ton **Projet D**, calibrée pour mettre en avant ton autonomie technique et ton esprit d'ingénierie :

Project D: Custom Hardware & Home NAS Badge: IT | Engineering

Objective: "To take on the technical challenge of designing and building a custom-made computer from scratch. My goal was to gain a precise understanding of the internal mechanics of each component to achieve the most optimized price-to-performance ratio, capable of meeting two main requirements: academic research and high-end leisure."

Methodology:

- **PC Assembly:** Selection and mounting of high-performance hardware components. Optimization of airflow and power consumption, along with advanced BIOS tuning to ensure system stability under heavy computational loads.
- **NAS Deployment:** Implementation of a Network Attached Storage (NAS) server to centralize data. Configuration of a RAID architecture to secure over 18 years of academic and personal archives against potential hardware failure.
- **Network Management:** Creation of a communication bridge between my workstation and the server via local and global networks to automate backups and guarantee secure access to laboratory reports and research data.

Technical Specifications:

- **Workstation:** CPU: Ryzen 5 5600X (6 cores @ 4200 MHz); RAM: 32 GB C16 DDR4 @ 3200 MHz; GPU: Radeon RX 6700 XT; MB: ASUS ROG STRIX B550-A; Storage: 1 TB NVMe M.2 SSD; PSU: 850W 80+ Gold.

- **NAS Server:** CPU: Intel Pentium Gold; RAM: 16 GB DDR4 @ 3200 MHz; MB: ASUS ROG STRIX B550-A; Storage: 2 x 4 TB in RAID 1 + 250 GB NVMe SSD; PSU: 450W 80+ Gold.

Personal Growth & Insights: "This project allowed me to achieve complete technical autonomy. Beyond the satisfaction of building my own professional tools, I am now able to diagnose, repair, and upgrade my hardware independently. These troubleshooting skills and my understanding of IT systems are valuable assets for managing the complex software and equipment used in modern chemistry laboratories."

Technical Details:

- **Date & Location:** 2021-2022 – Personal Lab / Home.

Voici la traduction en anglais pour ton **Projet E**, avec un vocabulaire scientifique précis et percutant :

Project E: Sustainable Chemistry: CO2 Valorization into Fuels and Materials
Badge: M1 | Green Chemistry

Objective: "To analyze technological solutions for capturing carbon dioxide (CO2) and transforming it into usable resources. The challenge was to understand how to convert industrial waste (a greenhouse gas) into a strategic raw material for methanol and polymer production."

Methodology:

- **Capture Technologies:** Comparative study between chemical absorption using solvents (amines) and physical adsorption on porous materials (Zeolites 13X), evaluating energy constraints for regeneration.
- **Fuel Conversion:** Analysis of catalytic hydrogenation processes for the production of methanol, a clean and transportable energy carrier.
- **Polymer Synthesis:** Study of CO2 copolymerization with epoxides (ROCOP process) to create polycarbonates, enabling the long-term storage of carbon within solid materials.

Key Skills (Arsenal):

- Sustainable Chemistry (Green chemistry & Circular economy)
- Catalytic Processes (Hydrogenation, ROCOP polymerization)
- Materials Science (Zeolites, bio-based polymers)
- Energy Transition Engineering

Personal Growth & Insights: "This project allowed me to step beyond the laboratory to understand large-scale industrial stakes. I gained a global vision of the energy transition: chemistry is not just about creating new molecules; it is the primary tool for closing the carbon cycle. It strengthened my ability to evaluate the real-world viability of a technology against current economic and environmental constraints."

Evidence: report_e.pdf

Technical Details:

- **Tutor:** Dr. Benoît LOUIS (CNRS Research Director, ICPEES).
- **Date & Location:** 2025-2026 – University of Strasbourg.

Project F: Molecular Modeling: Study of the Antimalarial Target PfATP4 Badge: L3 | Chemoinformatics

Objective: "To explore the structure and function of the PfATP4 protein—a vital sodium pump for the malaria parasite—using numerical simulation tools. The challenge was to characterize the molecular interactions between this target and inhibitors (such as Cipargamine) to understand resistance mechanisms."

Methodology:

- **Bioinformatics & Homology:** 3D protein structure reconstruction using cutting-edge tools (AlphaFold2, Swiss-Model) and sequence alignment (BLAST) to identify functional domains.
- **Molecular Docking:** Simulation of ligand binding to the protein using various algorithms (AutoDock Vina, smina, rxdock) to predict the most stable poses and binding energies.
- **Visualization & Structural Analysis:** Manipulation and rendering of complex biological structures in a Linux environment using PyMOL and VMD software.
- **Molecular Dynamics Preparation:** Parameterization of complex systems (ligand-protein-membrane) via CHARMM-GUI for subsequent simulations.

Key Skills (Arsenal):

- Molecular Modeling & Simulation
- Bioinformatics (AlphaFold, Sequence Alignment)
- Drug Discovery (Molecular Docking)
- Scientific Computing (Linux, Terminal)

Personal Growth & Insights: "This internship within the Theoretical Chemistry team (LIMA) was my first immersion into the 'Digital Laboratory.' I discovered that the computer is a construction tool as powerful as the lab bench. Transitioning from

handling test tubes to command lines provided me with a unique technological versatility. It reinforced my vision as an Architect: before physically building matter, we can now model and test it virtually to achieve ultimate precision."

Evidence: report_f.pdf

Technical Details:

- **Tutor:** Dr. Martin Spichty (Theoretical Chemistry Team).
- **Date & Location:** 2025 – Laboratory of Molecular Innovation and Applications (LIMA - UMR 7042), Mulhouse..