

UROP Department/Lab/Center: Chemical Engineering
Project supervisor: Marcel Amoros
Lab: J.-F. Hamel

Project Title: Oxygen Mass Transfer and Mixing Studies in Single-Use Bioreactors

Project Description: The purpose of this project will be to characterize biophysically the novel single-use bioreactors (SUB) through conducting oxygen mass transfer and mixing studies. Moreover, Microcarriers (a support for cells to grow) will be used in carrying out these studies since the final goal of the overall project will be to employ SUB in culturing adherent cells for the production of human vaccines.

In SUB technology, one of the primary limitations is in issues related to mixing and mass transfer. Cell culture is an aerobic process, and due to the low solubility of oxygen in the culture medium, oxygen transfer is often the rate-limiting step. Therefore, the mass transfer coefficient (k_La) is a critical parameter that should be determined in order to ensure an adequate delivery of oxygen to the culture medium and thus, a good design, operation, and scale-up of bioreactors.

As a UROP student you will contribute both to the experimental and analytical phases of this project, focusing more on the analytical tasks. You will learn how to work with SUB, along with the main components of a typical bioreactor, will pick up basic laboratory skills and techniques, and will have the chance to work with different types of equipment.

Prerequisites: An ideal candidate should exhibit self-motivation, interest in the bioreactor field, and the ability to work well both independently and with others. Furthermore, ideal candidates should be organized, dedicated, good communicators and innovative thinkers.

Prior lab experience is helpful, but not necessary. Strong candidates must demonstrate good analytical skills and knowledge of *Excel* / *Matlab*.

Contact: Interested candidates should send a copy of their resume and a brief description of their interest in this position to Marcel Amoros (mamoros@mit.edu) with a cc. to the lab PI (jhamel@mit.edu), with a subject of "UROP Application-Oxygen Project".

UROP Department/Lab/Center: Chemical Engineering
Project supervisor: Liz Yakaboski
Lab: J.-F. Hamel

Project Title: Culturing Chinese Hamster Ovary (CHO) Cells for Therapeutic Protein Production and Development of Novel Glucose Sensors

Project Description: The CHO project was initiated with the primary goal of studying the use of CHO cells for therapeutic protein production. In particular, the CHO team is interested in maximizing the production of therapeutic monoclonal antibody recombinant protein, while working to further understand and minimize the potential of these therapies to cause anaphylaxis reactions in humans. In addition to measuring and further characterizing protein production, an additional parameter that will be studied in this project is glucose uptake.

CHO cells are widely used in the production of biotherapeutics as CHO cells are known for producing proteins with human-like glycosylation profiles. (Glycosylation is a post-translational modification in which a glycan is attached to the protein.) This characteristic is important in that glycosylation affects not only protein function, but also can negatively impact the safety profile of the protein. In particular, murine cells lines that have been used in the production of biotherapeutics, including a monoclonal antibody used in cancer treatment (cetuximab), have been shown to produce proteins that contain a galactose- α -1,3-galactose antigen (α -gal) that can lead to anaphylaxis in patients with pre-developed antibodies. It has recently been demonstrated that different sub-clonal populations of CHO cells also produce proteins containing the α -gal moiety. Therefore, minimizing the expression of α -gal to improve the safety profile of the therapeutic protein is an important endpoint to study in addition to increasing overall protein production in CHO cells.

While the glycosylation studies are conducted by another MIT laboratory with which the CHO team is partnering, the CHO team in the Hamel laboratory is responsible for the cell culture aspects of the study. In quantifying overall protein production and characterizing CHO cell metabolism, the team has access to a variety of novel technologies. In particular, the team will have the opportunity to study and use a novel sensor system that has been developed to monitor the levels of monoclonal antibody protein and glucose, as well as other substrates, in real-time.

During initial phases of the project, candidates will be guided by senior members of the CHO team, with the ultimate goal of taking primary responsibility in culturing the CHO cells. Throughout the study, candidates will have the opportunity to gain experience in working with novel sensor equipment, and will be asked to compare their findings to other current sensor technologies.

Prerequisites: Ideal candidates should have an eager desire to learn, the ability to work well both independently and within a team, and an interest in cell culture and/or cell metabolism. Ideal candidates should be well-organized, responsible, dedicated, self-motivated, and good communicators.

Prior laboratory experience working with cell culture is required. Previous experience working specifically with mammalian cell lines, especially CHO cells, is highly preferred.

Contact: Interested candidates should send a copy of their resume and a cover letter briefly describing their qualifications for and interest in this position to Liz Yakaboski (yakabosk@mit.edu) with a cc. to the lab PI (jhamel@mit.edu), with a subject of "UROP Application-CHO Project".