

# Biomedical Technologies and Innovation Doctoral Programme (BIOTIN)



<b>Title of the PhD Project</b>	<b>Development of membranes for isolation and separation of extracellular vesicles</b>
<b>Acronym</b>	<b>MemEcV</b>
<b>Research Fields of the Project</b>	Membrane Science and Technology; Molecular Biology; Material Science; Biomedical Engineering
<b>Keywords</b>	Extracellular vesicle; Ultrafiltration Membrane; Isolation
<b>Host Institution, Department and Campus Location</b>	Izmir Institute of Technology (IZTECH), Department of Chemical Engineering, Urla, İzmir
<b>PhD Awarding Institution and Graduate Programme</b>	İzmir Institute of Technology, Graduate School, PhD in Chemical Engineering
<b>Name and Affiliation of Main Supervisor</b>	Prof. Sacide Alsoy Altınkaya (IZTECH)
<b>Name and Affiliation of Co-supervisors</b>	Prof. Amitav Sanyal (BOUN) Assoc. Prof. Özden Yalçın Özuysal, (IZTECH)
<b>Research Environment and Infrastructure</b>	<p>IZTECH has all the facilities for membrane preparation, testing and characterization. These facilities include membrane casting device, filtration set-up, surface charge, contact angle measurement devices, surface roughness and morphological characterization tools.</p> <p>IZTECH has all the facilities required to perform purity and content analysis of isolated extracellular vesicles. Briefly, basic BSL2 cell culture facility for functional analysis, western blot for protein analysis and real-time PCR for RNA analysis are available.</p>
<b>Scientific Context of the Project</b>	<p>This project includes three main sections. In the first section, the source of extracellular vesicles will be prepared from breast cancer cell lines MDA MB 231 and MCF7. Conditioned media will be prepared from the cell lines cultured in serum-free conditions.</p> <p>In the second part, new high flux ultrafiltration membranes exhibiting a low fouling tendency will be developed to isolate and separate extracellular vesicles. The membrane formulation will be optimized based on the filtration capacity, pore size, and recovery of the vesicles. The relationship between the morphological features of the membrane and its filtration performance will be investigated through detailed characterizations.</p> <p>In the third part, the isolated high-purity Evs will be characterized. EV markers and cargo will be analyzed by western blot and Real-Time PCR for protein and RNA</p>

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	content. Furthermore, the effect of isolated EVs will be compared to source conditioned medium in terms of cell proliferation and invasion.
<b>Brief Workplan</b>	Academic year of 2024-2025: Isolation and characterization of extracellular vesicles from different biological sources  Academic year of 2025-2026: Membrane development and characterization  Academic year of 2026-2027: Characterization of isolated high-purity EVs
<b>Innovative Aspects of the Project</b>	Size exclusion chromatography (SEC) and filtration are commonly used size-based separation techniques for extracellular vesicles (Evs) isolation. While SEC dilutes the isolates, filtration concentrates EVs, making them suitable for large-scale applications. The main challenge in filtration is the membrane fouling due to the deposition of EVs on the surface, causing reduced fluxes. To solve the low-flux problem, the transmembrane pressure is usually increased; however, this strategy may damage EVs. In this study, new high flux ultrafiltration membranes exhibiting a low fouling tendency will be developed to isolate and separate extracellular vesicles from different biofluids. The main motivation is to make the production method standardized, scalable, and cost-effective to isolate high-yield and high-purity EVs from various biological fluids.
<b>Training Opportunities of the Project</b>	The doctoral candidate will be trained in in vitro cell culture techniques and tests along with confocal/fluorescence microscope, flow cytometry, PCR and Western Blot analysis. They will have access to materials characterization instruments such as TEM, SEM, XRD, XPS, HPLC and they will be trained on these instruments as active users if need be. During their visit to International Academic Secondment, the candidate will also be granted access to wider University services including the library, IT services, as permitted to visiting scholars. CSU is in close proximity with Cleveland Clinic and Case Western Reserve University (CWRU), which is a very interactive and collaborative ecosystem. The Biomedical Engineering program at CSU operates in collaboration with world renowned Cleveland Clinic. Candidates will have opportunities to interact with Dr. Uz's collaborators at Cleveland Clinic Lerner Research Institute and CWRU. Thus, there will be ample opportunities to build relationships and to generate new collaborations.
<b>Interdisciplinary Aspects</b>	This project combines three interdisciplinary fields: membrane science and technology, molecular biology and biomedical engineering. Membrane development, surface modification and characterization in terms of filtration capacity, morphological features (e.g. pore size distribution, surface charge) require expertise in membrane science. Expertise from molecular biology is needed to provide the biological source of extracellular vesicle (EV) and the characterization of the isolated EVs in terms content and effect on cellular behavior. Biomedical engineering is involved in the project for the application of isolated Evs for diagnostic purposes.
<b>Intersectoral Mobility</b> <input checked="" type="checkbox"/> Short Visit <input type="checkbox"/> Secondment	<i>Host: AMGEN Türkiye</i>  <i>Context of Mobility: Management for the Pharmaceutical Industry</i>

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<b>Intersectoral Mobility</b> <input checked="" type="checkbox"/> Short Visit <input type="checkbox"/> Secondment	<i>Host: Istanbul Health Industry Cluster (ISEK)</i>  <i>Context of Mobility: Entrepreneurship Training, Thematic Pre-incubation Program</i>												
<b>International Academic Secondment</b>	<i>Host Supervisor: Dr. Metin Uz</i>  <i>Host Institution: Cleveland State University, Cleveland, USA</i>  <i>Host Department: Chemical and Biomedical Engineering</i>  <i>Duration: 6 months</i>  <i>Estimated Time of Mobility: 2024</i>												
<b>Main Supervisor</b>													
<b>Brief CV</b>	<b>Prof. Sacide Alsoy Altinkaya</b>  E-mail: <a href="mailto:sacidealsoy@iyte.edu.tr">sacidealsoy@iyte.edu.tr</a>  <b>ACADEMIC DEGREES</b> <table border="0"> <tr> <td>Ph.D.</td> <td>Chemical Engineering</td> <td>Pennsylvania State University, USA</td> <td>1998</td> </tr> <tr> <td>M.Sc.</td> <td>Chemical Engineering</td> <td>Ege University, Turkey</td> <td>1993</td> </tr> <tr> <td>B.Sc.</td> <td>Chemical Engineering</td> <td>Ege University, Turkey</td> <td>1991</td> </tr> </table> Google Scholar: <a href="https://scholar.google.com/citations?hl=en&amp;user=KkNm_8UAAAAJen">https://scholar.google.com/citations?hl=en&amp;user=KkNm_8UAAAAJen</a> <a href="https://orcid.org/0000-0002-7049-7425">https://orcid.org/0000-0002-7049-7425</a>	Ph.D.	Chemical Engineering	Pennsylvania State University, USA	1998	M.Sc.	Chemical Engineering	Ege University, Turkey	1993	B.Sc.	Chemical Engineering	Ege University, Turkey	1991
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<b>Brief CV</b>	<b>Assoc. Prof. Özden Yalçın Özuysal</b>  E-mail: <a href="mailto:ozdenyalcin@iyte.edu.tr">ozdenyalcin@iyte.edu.tr</a>  <b>ACADEMIC DEGREES</b> <table border="0"> <tr> <td>Ph.D.</td> <td>Life Sciences</td> <td>University of Lausanne, Switzerland</td> <td>2009</td> </tr> <tr> <td>M.Sc.</td> <td>Molecular Biology and Genetics</td> <td>Bilkent University, Turkey</td> <td>2004</td> </tr> <tr> <td>B.Sc.</td> <td>Molecular Biology and Genetics</td> <td>Bilkent University, Turkey</td> <td>2002</td> </tr> </table> Google Scholar: <a href="https://scholar.google.com/citations?user=sANbUOgAAAAJ&amp;hl=tr&amp;oi=en">https://scholar.google.com/citations?user=sANbUOgAAAAJ&amp;hl=tr&amp;oi=en</a> <a href="https://orcid.org/0000-0003-0552-368X">https://orcid.org/0000-0003-0552-368X</a>	Ph.D.	Life Sciences	University of Lausanne, Switzerland	2009	M.Sc.	Molecular Biology and Genetics	Bilkent University, Turkey	2004	B.Sc.	Molecular Biology and Genetics	Bilkent University, Turkey	2002
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<b>Brief CV</b>	<b>Prof. Amitav Sanyal</b>  E-mail: <a href="mailto:amitav.sanyal@boun.edu.tr">amitav.sanyal@boun.edu.tr</a>  <b>ACADEMIC DEGREES</b> <table border="0"> <tr> <td>Ph.D.</td> <td>Chemistry</td> <td>Boston University, USA</td> <td>2009</td> </tr> <tr> <td>M.Sc.</td> <td>Chemistry</td> <td>Indian Institute of Technology, USA</td> <td>1994</td> </tr> </table> Google Scholar: <a href="https://scholar.google.com.tr/citations?user=q5rblHkAAAAJ&amp;hl=tr&amp;oi=ao">https://scholar.google.com.tr/citations?user=q5rblHkAAAAJ&amp;hl=tr&amp;oi=ao</a> <a href="https://orcid.org/0000-0002-6966-0774">https://orcid.org/0000-0002-6966-0774</a>	Ph.D.	Chemistry	Boston University, USA	2009	M.Sc.	Chemistry	Indian Institute of Technology, USA	1994				
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