Vienna Calling - Innovations in Impedance-based analytical microsystems as advanced organs-on-a-chips

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Organ-on-a-chip technology has progressed from simplified “chip-in-a-lab” prototypes toward sophisticated, sensor-integrated microphysiological systems that recapitulate key aspects of human biology. Over the past decade, advances in automated microfluidics, tissue engineering, and embedded sensing have transformed these platforms into powerful tools for disease modeling and translational research. A central component of this evolution is the integration of impedance-based sensors, which enable non-invasive, label-free monitoring of cellular dynamics with high temporal resolution. By capturing changes in barrier integrity, cell adhesion, proliferation, and immune activation, impedance sensing provides a unique window into processes that are otherwise difficult to resolve in real time. At TU Wien, the *cellchip group* has contributed to this paradigm by developing novel electrode architectures, miniaturized sensor platforms, and integrative chip designs that enhance reproducibility and scalability across applications. Our research spans mucosal and gut-on-chip systems for host–environment interactions, vascularized platforms for infection and immunology, and sensor-embedded devices for studying inflammation, senescence, and transplant rejection. This presentation will provide an overview of our group’s work in impedance-enabled organ-on-a-chip systems, highlight lessons learned from integrating real-time sensing with complex biology, and outline the remaining challenges on the path toward multi-organ interoperability and a true “human-on-a-chip.” By bridging engineering, biology, and translational medicine, these technologies hold the potential to accelerate drug discovery, reduce reliance on animal models, and establish precision medicine platforms for the future.