

ARA - AIT Research Acceleration Platform

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According to an OECD analysis and that of Bloom et al., the leading R&D-performing countries in North America, Asia and Europe have all been experiencing a decline in average research productivity over the last two decades [1], [2]. With the emergence of AI as a new general-purpose technology, the future discovery of new materials or microbiomes will be driven by AI, which in conjunction with High-Performance Computing (HPC) and robotic automation (in autonomous laboratory platforms) will accelerate and enrich all stages of the discovery (and life) cycles [3].

Beyond those materials, Research Acceleration platforms (RAPs) will find their way in several other research fields that offer the application of AI on (big) data in correlation with high-throughput experimentation. Microbiomes play a key role for human, animal and environmental health, i.e., on One Health [4], and they are currently one of the key drivers of the bioeconomy. RAPs for microbiome research have not yet been established to accelerate the prediction of functions and microbial behaviour of microbiomes or microbial communities. However, the improvement and acceleration of microbiome-based predictions and microbiome engineering in a targeted and knowledge-based manner will be an important asset for further innovating the field.

AIT currently develops ARA, the AIT Research Acceleration Platform, composed of (see also figure 1):

- ARA-CORE: Core platform, hosting central IT-infrastructure, databases and AI-tools. ARA-Core will be operated in cooperation with the AIT AI Task Force and orchestrate and manage (virtually) connected self-driving labs (SDLs) [5], i.e.:
 - ARA-ESM: SDL for the development of Energy conversion & Storage Materials (ESM) through automated synthesis, characterization, and performance testing. For example, ARA-ESM can address the characterization and development of catalysts for water electrolysis or of innovative, advanced battery materials.
 - ARA-BIO: SDL for the development of a microBIOme modulator toolkit for prediction and modulation of microbial activities in agricultural and health relevant environments.
 - ARA-MET: SDL for the development of customized light-METal alloys (e.g. aluminium, magnesium or titanium) and their related production processes.
- In more detail, ARA-CORE, the physical node of ARA, will be integrated to AIT's main IT-infrastructure such as an HPC-Cluster, manage and secure the main data (bases), and operate the

applied AI-methods/AI-agents of/for each SDL. Thus, ARA-CORE will provide local computing power and possibly operate the interface external high-performance computing (i.e. AI Factory Austria AI:AT). Moreover, ARA-CORE shall (virtually) host and orchestrate the shared, AIT-wide use of certain (large) research infrastructure, e.g. analytical instrumentation for material characterization, which can be used by different SDLs. Finally, ARA-CORE will (virtually) manage all internal and external stakeholder interactions with ARA-CORE itself or one of the self-driving labs, to ensure, among other things, but above all, data security.

For developing, prototyping and testing within each special research domain, the individual Self-Driving Labs (SDLs) are being developed. Each SDL is composed of individual automatized tools or – more general - infrastructure that address one or several distinct topics within their domains. For example, ARA-ESM can address the characterisation and development of catalysts for water electrolysis or innovative, advanced battery materials (see also Figure 2), while ARA-BIO aims at the design of novel microbiome modulators, and ARA-MET – amongst others - focuses on the heat treatment of aluminium alloys.

In this presentation, we will introduce the concept and actual status of ARA and ARA-ESM.

Moreover, we will give an overview of our current work regarding fast-track catalyst discovery. We apply combinatorial deposition, high-throughput materials characterization and up-scaled electrochemical testing for the development of sustainable, CRM-free/-reduced material systems for low temperature (Proton- / Anion Exchange Membrane) electrolysis [6], [7], [8].

References

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Figures

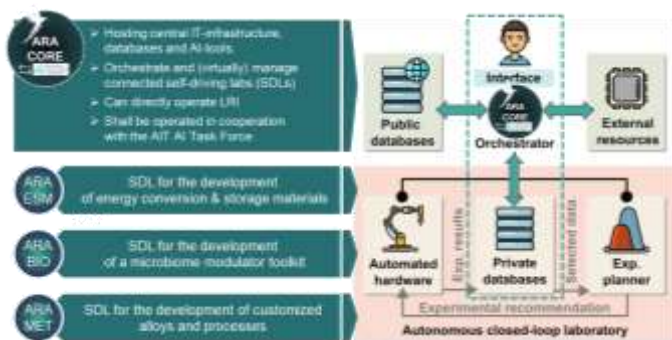


Figure 1. Schematic representation of ARA concept

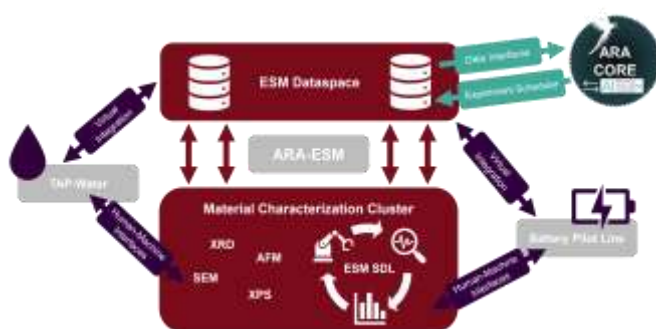


Figure 2. Schematic representation of ARAESM concept