Venerdì 11 maggio 2018 ore 10:00-12:30
Centro Congressi Santa Elisabetta (Pad. 13 Parco Area delle Scienze 93/A)

Latest advances in research projects on clean transport

Interverranno
Prof. Marcello Canova - Center for Automotive Research, The Ohio State University
Dr. Panayotis Dimopoulos Eggenschwiler - Swiss Federal Laboratories for Materials Science and Technology

Introduce
Prof. Agostino Gambarotta – Dipartimento di Ingegneria e Architettura, Università degli Studi di Parma

Advances in Electrified Powertrain Research at The Ohio State University

Dr. Marcello Canova

The Ohio State University Center for Automotive Research (CAR) has experience in research, development and prototyping of electric powertrains dating back to 1994, with focus on electric race vehicles, hybrid-electric and battery-electric vehicles and commercial vehicles. CAR's R&D activities in electric propulsion encompasses electric machine and power electronics design, modeling, system integration and prototyping of electrified powertrains. An important part of these activities focuses on energy storage systems for xEVs, including experimental characterization of performance and degradation processes, modeling, estimation and control, with a group of faculty and researchers with complementary expertise (from material science to physics-based modeling, to system integration and applied control), and 15 years of funded research projects with major automotive OEMs and Tier 1 suppliers.

This seminar provides an outline of the state of the art and R&D opportunities in the field of Lithium ion batteries for application to xEVs. Shortcomings including low energy densities, long recharge times, short cycle-life times and safety must be addressed. These challenges warrant a paradigm in research and advanced engineering that builds upon multi-disciplinary efforts in material science, experimental methods, modeling and simulation, systems integration and controls to effectively analyze and optimize the properties of new electrode materials and integrate them into advanced battery packs. A case study will be presented to illustrate the challenges and opportunities offered by advanced Silicon-based electrode materials in the development of the next-generation high energy density Lithium ion batteries.

Marcello Canova is Associate Professor in Mechanical Engineering and Associate Director of the Center for Automotive Research, at The Ohio State University. He earned his Diploma di Laurea "Summa Cum Laude" and his Ph.D. in Mechanical Engineering from the University of Parma (Italy).

Dr. Canova conducts research in the area of thermal sciences and energy systems, with emphasis on modeling, optimization and associated control problems. His research has been funded by, among others, Ford, General Motors, Fiat Chrysler Automobiles, Cummins, the National Science Foundation, the US Department of Energy and ARPA-E.
Dr. Canova is a 2016 NSF CAREER Award recipient, and he has earned the Kappa Delta Distinguished Faculty Award (2011), the SAE Vincent Bendix Automotive Electronics Engineering Award (2011), the Lumley Interdisciplinary Research Award (2012), the SAE Ralph Teetor Educational Award (2016), the Lumley Research Award (2016) and the Michael J. Moran Award for Excellence in Teaching (2017). He has published over 120 articles in peer-reviewed journals and conference proceedings.

Advances in Pollutant reduction at Swiss Federal Laboratories for Materials Science and Technology

Panayotis Dimopoulos Eggenschwiler, Dr sc. techn.

- Catalyst technologies, as introduced in the last 30 years in automobiles but also in other internal combustion engine applications, have succeeded in reducing emissions dramatically and have a significant contribution in the improving quality of ambient air. Catalytic acceleration of chemical reactions in the exhaust gases occurs on finely dispersed noble metal particles (Pt, Pd and Rh), who constitute a significant cost factor. Noble metal resource depletion is also becoming a concern of increasing importance.
The most common substrates for modern catalysts are honeycomb structures. The exhaust flow in the channels is laminar with low heat and mass transfer characteristics. For compensation, modern catalysts have far too large dimensions.
Catalysts based on specifically optimized engineered structures have the potential to reach high pollutant conversion performances with very low precious metal loading. The goal is the development of a catalyst having identical conversion performance with 1/3 of the precious metal amount as a state of the art, honeycomb based, benchmark catalyst. In parallel, no additional burden to fuel consumption by the different pressure drop characteristics in respect to the honeycomb benchmark should be evident.

- Emissions of gasoline powertrains at normal operating temperature are almost zero according to Euro-6 emissions limits. This is not the case during cold start. CO and unburned hydrocarbon (HC) emissions are 2-3 orders of magnitude higher. According to the emissions factor compendium cold start emissions of Euro 5 passenger cars amount to 68% of their total CO and 88% of HC emissions. Literally, modern engines emit during cold start the pollutant amount they would emit over more than 10'000km of warm operation. The higher efficiency of diesel engines on the other hand, results in significantly lower exhaust temperatures. Current developments for increased efficiency, lower fuel consumption and lower CO_2 emissions result in further decreased exhaust temperatures. Active catalyst heating by microwaves has been developed in this project. This was achieved by using low priced, mass-market components, for the microwave generation and transmission. A microwave absorbing material had to be introduced in the catalyst system while the package dimensioning was performed for achieving a good microwave resonator. The initial results show some 20% cold start emissions reduction with a typical 1000W household magnetron.

- Exhaust and non-exhaust traffic-related sources are estimated to contribute almost equally to traffic-related PM10 emissions. Non-exhaust particles can be generated either from non-exhaust sources such as brake, tire, clutch and road surface wear or already exist in the form of deposited material at the roadside and become resuspended due to traffic-induced turbulence. As exhaust emission controls become stricter, relative contributions of non-exhaust sources to traffic related emissions will become more significant and will raise discussions on possible regulatory needs. The aim of the present project is to provide morphological and physicochemical characteristics of brake wear particles.

Panayotis Dimopoulos Eggenschwiler is the Groupleader for Exhaust Aftertreatment at the Swiss Federal Laboratories for Materials Science and Technology, Empa.

Empa is one of the four research institutions of the ETH Domain in Switzerland.

He received his diploma in Mechanical Engineering from the RWTH Aachen University. He received the Dr. sc. techn. degree from the ETH Zurich (the thesis was awarded with the ETH Zurich medal). He worked for five years for IVECO in the development of the small heavy duty engines for the IVECO Turbo Daily (combustion and emissions lay-out of the first common rail engines as well as implementation and control of the first variable geometry turbocharger in heavy duty applications). He also completed the University of Rochester-Bern MBA. After three years in the software industry he joined Empa where he is leading the Exhaust Aftertreatment group since 2006. He is teaching Exhaust Aftertreatment systems at the ETH Zurich and at the Università degli Studi di Parma