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The European Sensor Systems Cluster - ESSC: A New EC Initiative

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Abstract

This is a is a short overview of the European Sensor Systems Cluster (ESSC), that is an EC initiative, launched on November 2014, to maximize impact of the FP7/H2020 research and innovation projects for industrial leadership and key enabling technologies applications. The ESSC cluster has already involved 7 FP7/H2020 projects, European networks and platforms, 13 founder organizations with at least 40 members from more than 15 Countries (June 2015).

Key words: Chemical Sensors, Sensor-Systems, Industrial Relevance, EC DG R&I Clusters.

Introduction

The European Commission launched a new initiative in the field of Research & Innovation with *European Clusters* to promote international cooperation, create critical mass in Science & Technology and maximize impact in strategic key sectors for European economic growth with high industrial relevance. The European Sensor Systems Cluster (ESSC) [1] (see logo in Figure 1) was launched in Brussels on 27 November 2014 under sponsorship of the *DG Research and Innovation, Directorate Key Enabling Technologies - Unit Advanced Materials and Nanotechnologies*, with *Dr. Hans-Hartmann Pedersen* (EC Research Programme Officer) as EC Observer. This meeting in Brussels was attended by at least fifteen FP7 and H2020 project coordinators and other representatives from research institutions and SMEs. ESSC is one out of the 19 European Clusters managed/ observed by DG R&I - KET - Unit Advanced Materials & Nanotechnologies.

The expectations from EC on Clusters are:

1. Increase the impact of research funded under the H2020 NMBP Programme from a *i*) scientific, *ii*) technical and *iii*) commercial point of view.
2. Facilitate networking and help projects to benefit from synergies.
3. Obtain better advice for future policy and call preparations (roadmaps, inputs for call topics, long-term research goals).
4. Improve impact, exploitation and knowledge management.
5. Raise visibility of public funded research activities and their impact.

The ESSC will identify technical or non-technical challenges for (bio)chemical sensing and highlight opportunities resulting from nanotechnology, microsystems integration, advanced data evaluation, their systemic integration as well as manufacturing and commercialization based on an application and demand driven approach (see Figure 2).

ESSC will mobilize a pan-European network, ready to advise, assist and implement national and international measures to strengthen the position of European research and innovation. The ESSC key areas have been identified:

- Environmental Sustainability
- Energy Efficiency
- Health Monitoring
- Comfort
- Industrial Applications

Fig. 1. ESSC logo.

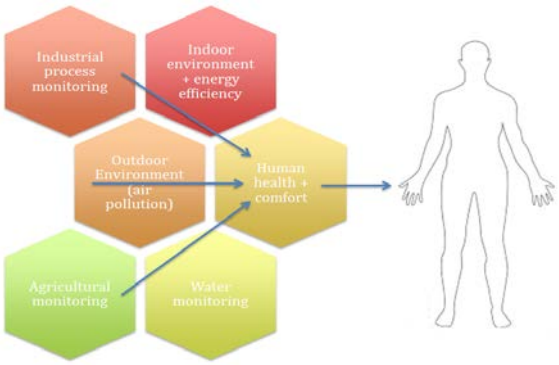

Fig. 2. Scheme for the Vision of the ESSC.

Objectives

The Main objectives of ESSC are listed, but not limited to:

- Maximize the cooperation between projects (avoid duplicating work and improve efficiency)
- Identify common interests in on-going research and development (e.g. open calls, training)
- Provide a forum for discussion, problem solving and analytical planning R&D activities in Europe
- Establish the EU-wide meeting platform for researchers and mainly for involved industries and end-users
- Remove commercialization barriers to ensure the EU leadership in Sensor Technologies
- Integrate inputs and recommendations from other existing clusters or groups
- Promote the connection with external bodies (EC-RTD, Connect, standardization and regulatory bodies, journals and scientific boards, advisory boards)
- Disseminate the sensor-related issues/findings to informed public (e.g. stimulate awareness for the invisible environmental problems and support *citizen science*).

Technological Challenges

The Roadmap will be mainly focused on the technological challenges as defined shortly:

- Indoor Sensing
- Environmental Sensing
- Biosensors
- Chemo/bio Sensors for Liquids
- Modelling and Simulation
- Analytical Tools and Metrology
- Standardization and Regulation
- Business Models and Spin-offs

Furthermore, an extended Roadmap is expected to be completed by Autumn 2015. This will be published in ESSC webpages [1] and disseminated in specific events with international relevance in targeted S&T communities, industry and in particular SMEs.

Preliminary Inputs for Roadmap

The ESSC Steering Committee and WG Leaders have discussed and proposed some future research activities at high added value for innovation in the field of sensor systems and related commercialization. These inputs will be organized in a structured and prioritized Roadmap, expected to be presented on September 2015. The particular challenges are identified, where R&D efforts should be invested:

- **Improved 3S of Sensor Materials and <u>More 3S</u>**
  - Sensitivity, Selectivity, Stability
  - Response/Recovery Time, Repeatability, Resolution
- **Miniaturization and Integration**
  - Low-powered Sensors
  - Chemical Filters
  - Catalysts
  - Pre-concentrators
  - Low-cost Modules
  - Sub-systems
- **Integration to Systems**
  - Energy Consumption/Harvesting
  - Data acquisition and Filtering
  - Data Fusion
  - User Interaction
- **Indoor Sensing**
  - Cross-sensitivity to specific gases (e.g. fatty acids)
  - Accurate VOC quantification
  - Long term exposure quantification
  - Stability and life expectancy
  - Miniaturization, low consumption, controlling and data processing
  - Integration to air treatment systems and HVAC (incl. occupancy)
  - Human machine interface for comfort
- **Environmental Sensing:**
  - Scalable sensing models for building Sensor Networks to track key air/water quality parameters
  - Sensors complementary to existing tools (larger devices)

- Integration to mobile devices
- Low cost, wireless sensors to form networks (e.g. sensing cities)
- Targeted information to habitants and mitigation
- Nanoparticle detection for dust and aerosols

- **Biosensors**
  - Disposables vs. continuous/automatic monitoring
  - High throughput
  - Regulatory framework not fully adapted to personalization
  - Towards point of care diagnostics, incl. Telemonitoring
  - Data integrate-ability in health system
- **Chemo/Bio Sensors for Liquids**
  - High potential, but low progress
  - Multiparametric approach should be investigated
- **Modeling and Simulation**
  - Multi-physics model: analyte flow, material layer, transduction, data processing, integration
- **Industrial Process Monitoring**
  - Better control of processes by increasing the number chemical parameters to be determined continuously (robust sensors needed)
- **Analytical Tools and Metrology**
  - Validation
  - Joint-exercises sensors-versus-analysers in real scenario measurements
  - Measurement protocols for benchmarking
- **Standardization and Regulation**
  - Standards and data protocols for Data Benchmarking (open access)
  - Validation and standardization of measurement procedures
  - Advanced study of VOC impact on health/productivity
  - Harmonization/Regulation/Public information of measured sites/households
  - Regulation/Public info on industrial products - e.g., real time styrene monitoring
- **Business Models and Spin-offs**
  - Total cost of ownership vs. savings in comfort environment
  - Food quality monitoring and price adaptation (real-time S/D)
  - Health system rewarding for early testing and monitoring

Some examples of gas sensors and innovative sensor-systems are reported in the Figure 3 and Figure 4.

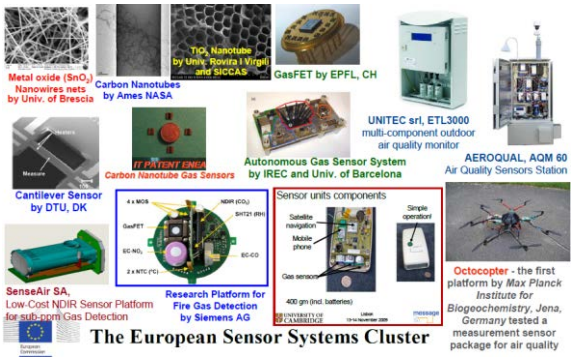

Fig. 3. Some examples of sensor materials, gas sensors and sensor-systems from research and innovation community EuNetAir.

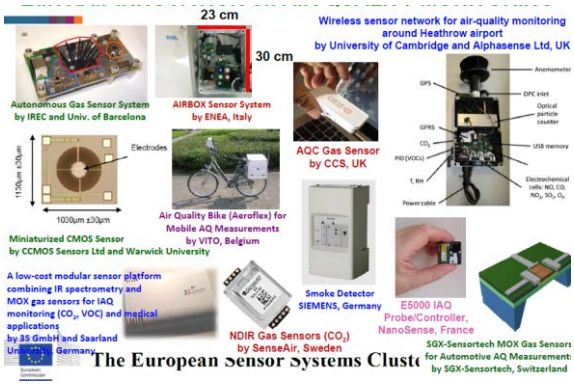

Fig. 4. Some examples of innovation on sensor-systems for air quality monitoring from research and innovation community EuNetAir.

Working Groups and Governance

The work plan is organized in six complementary Working Groups (WGs), each devoted to a progressive development of chemical sensors, sensor systems, industrial applications and commercialization. The six WGs with their specific objectives are guided by a WG Leader:

- **WG1**: *Environmental Sensors* (Prof. Dermot Diamond, Dublin City University, Ireland)
- **WG2**: *Indoor Air Quality* (Prof. Andreas Schütze, Saarland University, Germany)
- **WG3**: *Health Monitoring and Comfort Sensors* (Prof. Paul Galvin, Tyndall National Institute, Ireland)
- **WG4**: *Monitoring of Industrial Processes* (Prof. Torsten Mayr, Technical University of Graz, Austria)
- **WG5**: *Sensor System Integration and Commercialization* (Olivier Martimort, NanoSense SARL, France)

- **WG6**: *Dissemination and Outreach* (Dr. Thomas Simmons, AMA Association for Sensors and Measurement, Germany).

Finally, the ESSC governance is completed by:

- **Chairman of ESSC**: Michele Penza, ENEA, Italy
- **Coach of ESSC**: Rudolf Frycek, Amires, Switzerland
- **EC Observer**: Hans-Hartmann Pedersen *(EC Officer),* DG R&I, Brussels, Belgium.

Partners Supporting ESSC

The ESSC is supported by various organizations and institutions from academia, research, industry, SMEs and associations including:

- ENEA (Italy)
- Saarland University (Germany)
- Dublin City University (Ireland)
- Tyndall National Institute (Ireland)
- Graz University of Technology (Austria)
- Denmark Technical University (Denmark)
- Brandenburg University of Technologies (Germany)
- NanoSense Sarl (France)
- Efficience Marketing (France)
- Nanoanalytik GmbH (Germany)
- Amires Sarl (Switzerland)
- Eurice GmbH (Germany)
- AMA Association (Germany)

FP7/H2020 Projects and EU Initiatives Supporting ESSC

The ESSC is supported by various FP7/H2020 projects and EU initiatives [2-5] including:

- COST Action TD1105 (EuNetAir) - *European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability*
- NanoMedicine - *European Technology Platform*
- SENSIndoor (FP7 project): *Nanotechnology based intelligent multi-SENsor System with selective pre-concentration for Indoor air quality control*
- IAQSense (FP7 project): *Nanotechnology based gas multispectral sensing system for environmental control and protection*
- NAPES (FP7 project): *Next Generation Analytical Platforms for Environmental Sensing*
- AQUAVIR (FP7 project): *Portable Automated Water Analyser for Viruses*
- NANODETECTOR (FP7 project): *Ultrasensitive Plasmonic Detection of Single Nanoparticles*.

Conclusions and Outlook

The context policy of EU Clusters is related to the Smart Specialisation Strategy for Regional Growth and EU Cohesion Policy. More information can be found in the EC Report on *Innovation Clusters in Europe*: *A statistical analysis and overview of current policy support* by DG Enterprise and Industry [6].

The ESSC is proposed to maximize impact in the field of chemical sensors, sensor systems and sensor applications at industrial relevance for supporting European leadership. The ESSC is an Open Cluster and new Members are welcome to create a critical mass in the sensor systems and related technologies. The ESSC has already published the *Position Paper* [1] and will publish a *Roadmap* on the strategic topics identified as challenging, cross-cutting and innovative for sensor systems applications in the different market-oriented sectors.

Acknowledgements

The *ESSC* thanks all members for their active role in and contribution to the EU cluster.

References

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