An overview of some science capabilities found within CSIRO's Division of Materials Science and Engineering. i-DUST 2010, Apt, France

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ABSTRACT

CSIRO is a multi-disciplined, Australian government funded, science organisation whose major aims include the investigation of science issues that are of particular relevance to Australia. The organisation has over 5800 employees. A broad outline of some of the capabilities found within CSIRO is available via a web site [1]. Some of CSIRO's capabilities could potentially be incorporated into future "underground science" projects.

INTRODUCTION

CSIRO's capabilities are based in the individual and collective expertise of the scientists and technicians working in the agricultural, information science, environment, health, mining, energy, manufacturing and materials sciences.

The CSIRO Division of Materials Science and Engineering (CMSE) is home for over 480 CSIRO staff. Science disciplines found within CMSE include understanding and application of the properties of metals and ceramics, thin films, textiles, forest polymers and wave physics, superconductivity and fluid dynamics. Within these disciplinary grouping, there would appear to be many opportunities to contribute to future "underground science" projects.

WAVE PHYSICS

The CMSE "Wave Physics" group is home for specialists in optics, ultrasonics and acoustics, x-ray science, photonics and intelligent sensor networks.
Examples of projects that use these capabilities are distributed optical fibre sensing systems for strain, temperature etc, opto-acoustic instrumentation for bathymetry, ultrasonic instrumentation for NDE of composite materials, high performance real-time synchrotron XRF imaging, distributed intelligence networks for structural and condition monitoring and computed X-ray microtomography of mineral and rock samples.

FLUID DYNAMICS

The "Fluid Dynamics" group of scientists who collectively have an understanding of the fundamental, computational and experimental aspects of fluid dynamics.

Capabilities found within this group include an understanding of multiphase mixing and separation, combining fluid dynamics and other physical phenomena to enhance fluid-based reactions, and developing an understanding of fluid/ physical structure interactions that leads to being able to control and manipulate these interactions.

Sub-surface systems account for vast amounts of the world's natural wealth, including energy (geothermal, petroleum, gas, uranium), minerals, and water. CSIRO scientists have modelled methods to double the extraction rate from sub-surface systems using chaotic advection to generate sub-surface stirring of injected fluids. Future work is aimed at both larger scale experiments and models to further understanding of control mechanisms and how to best augment the transport between the fluid and the sub-surface resource.

SUPERCONDUCTIVITY & MAGNETISM

Projects within the "Superconductivity and Magnetism" group include the design, fabrication and deployment of superconductor-based, magnetic field magnetometers and gradiometers systems aimed at application in the minerals exploration, food quality assurance, environmental protection and defence industries.

A patented step-edge junction technology forms the basis for many of our high temperature superconductor devices. This technology is used in our emerging THz imaging and radio frequency oscillator and mixer devices.

The properties of nano-SQUIDs, SQUIDs with nano-sized loop structures, are being investigated as possible photon detectors or read-out devices for quantum qubits.

The design of highly efficient electrical motors and generators is undertaken within this group. Applications include efficient motors for "solar car" racers, air-conditioning systems and hybrid automobiles.

OTHER CSIRO CAPABILITIES

CSIRO has capability in the understanding of rock mechanics, in bore-hole instrumentation and CO2 sequestration. Reference to these activities may be found via the CSIRO web-site.

REFERENCES

[1] http://www.csiro.au/org/About-CSIRO.html