Inauguration of the newly upgraded Chemistry Building:
World class research centre

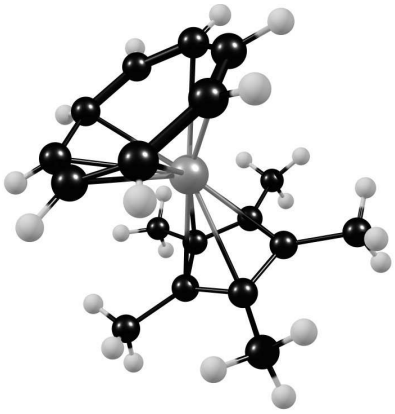
The Chemistry building is newly renovated for more than R60 million and new apparatus is installed for more than R50 million, that is ‘n total investment of more than R110 million. It took more than 5 years to complete the upgrading. The largest contribution came from the UFS, but SASOL and the National Research Fund (NRF) each contributed more than R20 million for different projects during the past 5 years. The specialist research areas of chemists at the UFS include X-ray crystallography, electrochemistry, synthesis of new molecules, development of new methods to determine rare elements such as zircon, tantalite and columbite, purifying of water as well as the measuring of energy and temperatures responsible for phase transitions in molecules, the development of agents to observe CANCER and other defects in the body and many more. We have top expertise on numerous areas, with excellent equipment and we compete with the best laboratories in the world. We have collaboration agreements with more than 20 respected national and international chemistry research groups.

Presently we deliver inputs on technical aspects of ACID MINE WATER in Johannesburg and surroundings, as well as the FRACKING in the Karoo to deliver gas.

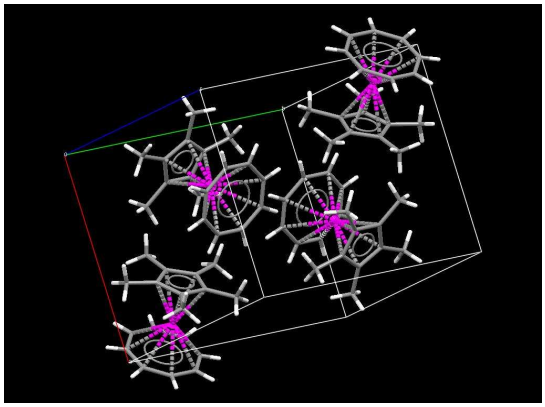
Equipment installed in the department of chemistry during the upgrading:

1. X-ray diffractometers (Cost: R5 Million) for crystal research:

Crystals of unknown compounds are investigated on a X-ray diffractometer. The bond lengths in angströms (1 angström is a ten billionth of a meter), angles between the atoms, the exact arrangement of the atoms in the crystal and the precise composition of the molecules in the crystal are determined.



5- & 8- member rings with erbium as central atom

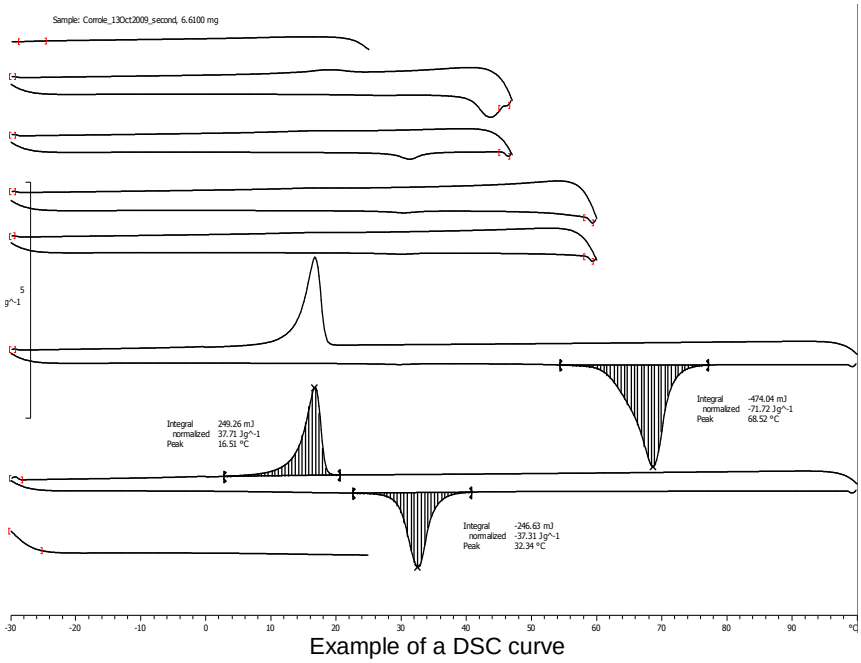


Unit cell arrangement of the 5- & 8-member rings with erbium as central atom

2. Differential scanning calorimetry (DSC) for thermographic analysis (R4 million)

Study of heat transfer and the changes associated with it for e.g. volcanoes and catalytical reactions for new fuel. We measure the temperature changes associated with the phase changes of liquid crystals (watches and TV-screen) of solids to liquids.

Consecutive photos of acetyl ferrocene during cooling at different temperatures (different phases during cooling is shown)



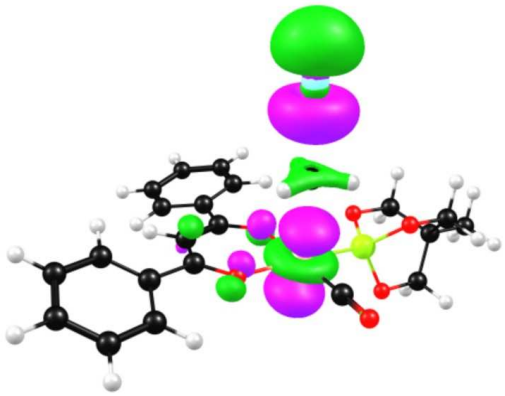
Example of a DSC curve

3. Nuclear magnetic resonance spectroscopy (NMR): Bruker 600 MHz ; R12 Million, one of the most advanced systems on the continent of Africa)

A NMR apparatus is related to the apparatus used for Magnetic Resonance Imaging which is used in hospitals to look at defects and affected parts due to illness inside the bodies of patients. The patient is place inside a “tunnel” and the different biological molecules are activated by the magnetic fields to generate an image of the affected limb which can be studied by the doctor. In chemistry a NMR is also used to determine the structure of unknown compounds and to determine the degree of purity of a sample. Important structure characteristics of molecules can be concluded which is very important if this molecule is used as medicine to predict possible side-effects.

4. High performance computational centre (HPC) (R5 Million)

Presently the HPC of the UFS consists out of approximately 900 computer nuclei, that is the equivalent of 900 normal personal computers, combined in one compact system. The HPC can handle calculations on a billion data point level. Chemists use computers to calculate the geometry and spatial orientations, energy and properties of molecules. The larger the molecule, the more powerful the computer must be to do the calculations. Computational chemistry is exceptional handy to calculate molecular properties in the absence of X-ray crystallography data. Some reactions is so fast that intermediate products cannot be characterised and then computational chemistry is of indispensable value.



Calculated model showing the orbitals

5. Catalytic and high pressure apparatus (R6 Million; one of the most advanced apparatus in the world)

The pressures that can be achieved (in comparison with the pressure in tyres) are: in gasses (100 times higher) and in liquids (1500 times) and the apparatus is used to study very special reactions. The aim of the research (some aspects in collaboration with SASOL) is to develop new fuel and fuel additives and to add value to local chemicals.

6. Reaction velocity apparatus (Kinetics: R5 Million; one of the most advanced apparatus in the world)

The rate of reactions can be studied in the ultraviolet, visible and infrared regions on the millisecond level, and if combined with the NMR discussed above, on the micro-second level (that is a millionth of a second). Typical reactions are for e.g. the human respiration process (uptake of oxygen in the lungs), uptake of agents in the brain, decomposition of nano materials and proteins, acid – and base catalysed reactions, polymerisation reactions (synthesis of plastics) and much more.