Executive Summary

The mining industry needs to enhance liberation and separation of minerals and reduce energy consumption in order to increase efficiency and treat the lower grade ore bodies. The industry aims to achieve higher throughput, whilst increasing the limit of grind, increasing recovery of metal. Research work by the proposers of this project has shown that microwave treatment of ores prior to comminution can induce fracture around individual mineral grains leading to enhanced processing and potentially improved process economics.

Previous work on microwaves in the minerals industry utilised low power systems that necessitated long residence times. In addition, small sample masses were used which led to poor energy balances (microwave energy input > 40 kWh/t). The proposers of this project have adopted a different strategy, combining sound fundamental understanding and interdisciplinary skills, to achieve significant process benefits at a microwave energy consumption of less than 0.5kWh/t. In addition, further understanding will be developed by carrying out, for the first time, a full evaluation of pulsed technology. If successful, this will lead to even lower microwave energy consumptions, significantly higher throughputs and potentially the liberation of minerals at their natural grain size.

Two options are offered for the first year of this four year project, whose ultimate aim will be to design and build a large scale demonstration plant.

A basic option for sponsors who wish to perform preliminary evaluation of the technology for their ores and who wish to assess the effects of treatment themselves.

An extensive option for sponsors who wish for more extensive and optimised evaluation, which will include testing at a range of higher power densities, detailed dielectric property measurements development of design concepts for continuous operation and full techno-economic evaluation for the design concepts.

The potential benefits to sponsors are:
The gated nature of the programme means that sponsors will be able to assess the technology as appropriate to their needs during the first year of the programme. The first year will provide sponsors with a preliminary evaluation opportunity prior to committing to the major 2 year phase that will follow. The first phase will also identify the specific process benefits that can be achieved for each of the sponsors, which could be in terms of selective breakage, enhanced liberation and reduced comminution energy etc. In years 2-3, sponsors will be able to evaluate their own materials at pilot scale and receive the basic enabling knowledge to decide on likely process benefits with other materials without significant further testwork. It will then be possible to readily quantify benefits at scale and allow scope estimate economic analyses to be carried out.

The project will allow sponsors to evaluate their ores in a custom designed pulsed microwave test system not available elsewhere. The output from year 4 will allow sponsors to test their ores on site with an engineered, robust 20-100 tph microwave treatment system. In addition, the project will provide the scientific and engineering basis to allow individual sponsors to develop microwave technology for their own specific applications and ore types outside the remit of this project e.g. hydrometallurgy and pyrometallurgy.

Chalcopyrite grain surrounded by calcite showing phase boundary fracture as a result of pulsed microwave

Project Leaders
Dr Sam Kingman (Nottingham) and Prof Steven Bradshaw (Stellenbosch)

Research Institutions
Universities of Nottingham (UK) and Stellenbosch (RSA), e2v Technologies

Project Duration
Four (4) Years, gates after years 1 and 3

Project Status
Under circulation

Project Type
Mineral Processing

Sponsorship
Year 1 Basic option A$66 700, Extended option A$123 750

Confidentiality
A standard AMIRA project confidentiality agreement will be executed. Sponsors retain a royalty free, perpetual, non-exclusive license to use research project technology in their own operations.

Further Information
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