



DR. IVAN K. SCHULLER
DISTINGUISHED PROFESSOR
DIRECTOR
CENTER FOR ADVANCED NANOSCIENCE (CAN)
9500 GILMAN DRIVE
LA JOLLA, CALIFORNIA 92093-0319

MAYER HALL, ROOM 3230
TEL: (858) 534-2540
FAX: (858) 534-0173
E-MAIL: ischuller@ucsd.edu
WEBSITE: <http://ischuller.ucsd.edu>

INSTRUCTIONS FOR UCSD MFMMS SERVICE:

The Magnetic Field Modulated Microwave Spectroscopy (MFMMS) system is designed for detecting small amounts of superconducting (SC) material using Microwave absorption signal which is recorded as a function of temperature. Typically the SC transition is recorded as a peak in the MFMMS absorption [1,2,3]. Above the T_c , the MFMMS signal is reduced to the noise level. Since the MFMMS response depends on different sample parameters such as: dimensions and mass, form (powder or thin film), position inside the cavity, etc... it is not possible to give a quantitative analysis of the data other than an estimate value of the T_c [1].

In order to do a reasonable use of the system and to restrict the amount of time spent by us, we would appreciate some experimental justification for the interest of the samples. If you plan to send a set of samples it would be helpful to have some preliminary data about some of the samples (X-ray, SQUID or transport). In case you have an estimation of the superconducting volume fraction of your samples you should check if it falls within the resolution limit of the system. The sensitivity of the system is high enough to detect 10^{-12} cm^3 superconducting volumes of Nb dots prepared by electron beam lithography. Samples with a high dielectric constant or highly absorptive are lowering the sensitivity. If the sample has a metallic layer(s), one should consider the skin depth of microwaves to be able to see the signal coming from the SC.

SAMPLE TUBES:

We will provide high purity quartz sample tubes for measuring powder, pellets, chunks, etc.... See sample preparation section. For thin films we use a flat ended high purity quartz rod. You could send the films and we will mount them on the holder. Maximum dimensions for thin films: 4 mm x 5 mm x 1 mm.

SAFETY NOTICE:

We **cannot** accept any of the following sample types:

- Biohazard or Human-Derived Materials
- Non-Sterilized Regulated Soils
- Radioactive Materials
- Explosives or Unstable Materials

Note: We do not accept materials that possess > 1 of the following hazards: *flammable*, *corrosive* and *oxidizer*

SCAN PARAMETERS:

In order to maximize the SC detection, the BEST starting parameters (already tested for known superconductors) are:

- Microwave frequency (X-band, 9.4GHz)
- AC Magnetic field amplitude: 15 Oe
- Microwave Power: 1 mW
- AC Magnetic field frequency: 100 KHz
- DC Magnetic field: 15 Oe.
- Temperature: 150 to 4.5 K; 0.05K resolution

Note that the standard temperature scan is from 150 K to 5 K in 30 minutes. If it is specifically requested it would be possible scan from 300 K to 5 K in 1 hour. The lowest temperature is 4.2 K.

SHIPPING:

Users are responsible for shipping samples to UCSD in full compliance with DOT rules and regulations. You may use a commercial shipping company (FedEx, UPS, DHL, etc). We recommend protecting samples in bubble wrap (provided) or some other padding during shipment. Email notification will be sent when samples are received at UCSD.

Samples should be shipped to this address:

Ali Basaran / Ivan K. Schuller (Phone 858-534-2778)

UC San Diego, Department of Physics

MH3214, 9500 Gilman Drive

La Jolla, CA 92093-0319, USA

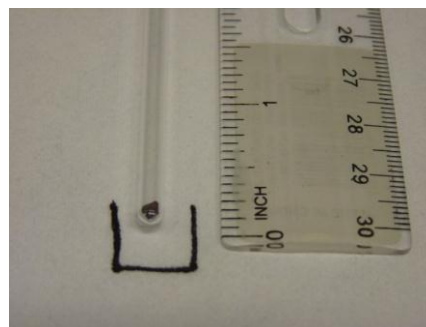
SAMPLE PREPARATION:

Sample preparation is critical and can dramatically impact the quality of your collected data. Consult us with any questions on sample preparation before shipping your sample(s), abasaran@ucsd.edu

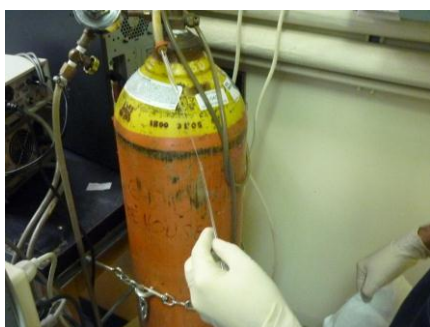
1.- High purity quartz with an inner diameter of 3 mm are provided.



2.- Insert your sample inside the tube. **Typically 50 to 100 mg (maximum).**



3.- Fill the tube with ultra-high purity Helium gas.



4.- Seal the tube using Parafilm®



DISPOSAL:

By default, all samples sent to UCSD will be saved for a minimum of two weeks after data collection before being disposed. Under special circumstances, samples may be returned if requested in advance. Users requesting sample return should arrange for payment of shipping costs (e.g. FedEx #, etc).

CITATION POLICY:

All published reports of work conducted using MFMMS must contain in the following acknowledgement: "Use of the MFMMS was supported by the AFOSR MURI grant Search for New Superconductors for Energy and Power Applications". For a citation with a description of the technique use *J. de la Venta et al., Supercond. Sci. Technol.* **24**, 075017 (2011).