LT22

A new superconducting reference device for thermometry below 1000 mK

NMi Van Swinden Laboratorium

Arnold J. Storm,
Martin J. de Groot

P.O. box 654, 2600 AR Delft, The Netherlands
Contact: mdegroot@nmi.nl

Hightech Development Leiden

Wim A. Bosch,
Frans Mathu

Zeeforel 4, 2318 MP Leiden, The Netherlands
Contact: hdleiden@xs4all.nl

Kamerlingh Onnes Laboratorium

Reyer Jochemsen,
Gerard J. Nieuwenhuys

Leiden University, P.O. box 9504, 2300 RA Leiden, The Netherlands
Contact: reyer@phys.leidenuniv.nl

ABSTRACT

Research has been carried out on technology for a new superconducting reference device for thermometry between 10 mK and 1000 mK, the SRD1000. The device uses superconducting transitions of various materials to establish high precision reference points on the temperature scale.

GOAL

Development of a prototype SRD1000, suitable for convenient transfer of a future ultra-low temperature scale to its users.

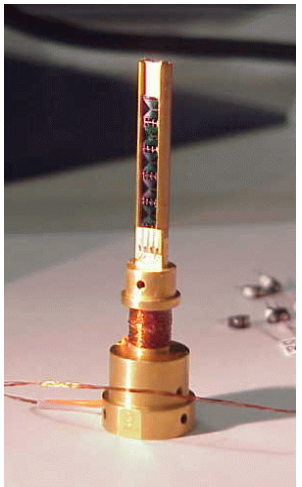
SRD1000 SENSOR

To detect the superconducting to normal transitions, a new technique has been developed using a set of niobium planar microcoils, deposited on a silicate substrate. To avoid shifts of the transition temperature due to magnetic fields, the sensor is contained within a set of magnetic shields.

SELECTED REFERENCE POINTS

Presented in the table are the materials selected for the SRD1000, together with observed transition temperatures and widths using two prototypes of the sensor.

Prototype SRD1000 sensor



NEW MATERIALS

Compared to the former SRM768 device, the Be point at 23 mK was omitted and alloys of iridium and rhodium are used instead. The use of these alloys for superconducting reference points is new. This research has shown that they can provide excellent reference points (see graph for transition of $Ir_{80}Rh_{20}$) in the range from 25 mK to 100 mK, where no alternative materials are available**.**

FUTURE WORK

Next year a pilot series SRD1000 sensors will be tested at standards laboratories throughout Europe, to determine the accuracy and reproducibility of the reference points. In about 2 years, we expect the SRD1000 to become commercially available, complete with electronics and calibration certificate.

CONCLUSIONS

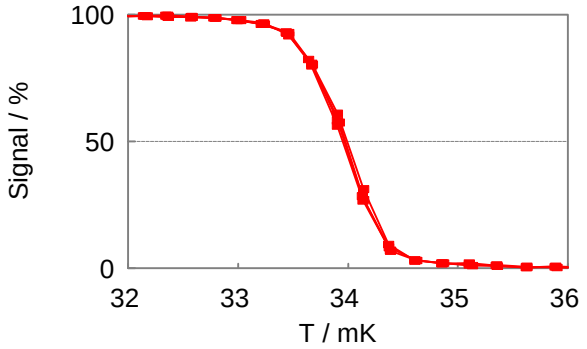
Prototypes of a new superconducting reference device with ten materials have been tested. Sharp transitions have been obtained for all materials, except for W and $Ir_{73}Rh_{27}$. The reproducibility of the transitions has yet to be determined.

SRD1000 materials and prototype test results

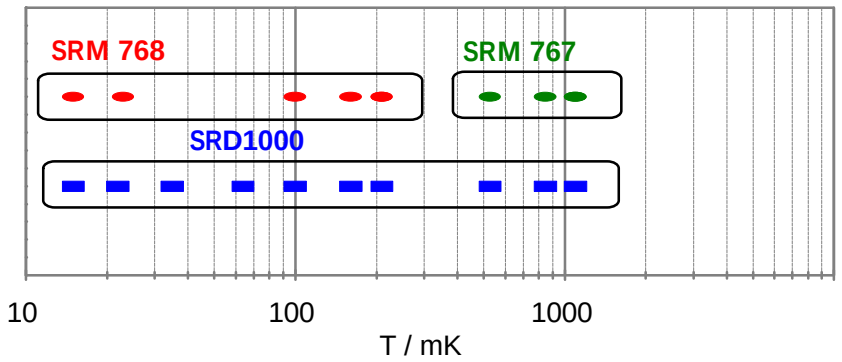
material	T_c / mK	Width / mK
W	15	*)
$Ir_{73}Rh_{27}$	22	*)
$Ir_{80}Rh_{20}$	34	0.9
$Ir_{92}Rh_{08}$	61	0.5
Ir	106	2
$AuAl_2$	161	0.3
$AuIn_2$	208	0.4
Cd	540	3.5
Zn	850	3
Al	1134	<10

*) Transition not yet observed with the present prototype

Superconducting transition of $Ir_{80}Rh_{20}$



Comparison of SRD1000 reference points with those of the former SRM767/768 devices from NBS, U.S.A.



Visit the SRD1000 web page for additional information: **http://www.xs4all.nl/~hdleiden/srd1000.htm**