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The Preparation of ACEL Thin Films

by

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R&D 5910-EE-01 Contract DAJA45-88-C-0002

2nd Periodic Report

Reporting Period: 1st December 1987-31st January 1988

The research reported in this document has been made possible through the support and sponsorship of the U.S. Government through its European Research Office of the U.S. Army. ~~This report is intended only for the internal management use of the Contractor and the U.S. Government.~~

MOCVD Thin Films for ACTFEL Devices

1.0 Introduction

The initial three month programme has now been completed, and a further three month extension awarded. Clearly, the initially submitted programme and objectives have required drastic modification in order to accommodate the request by the USAC for complete ACTFEL device structures within the next three months. The following report reflects this shift in emphasis.

2.0 The Present Position

2.1.0 Organometallic Source Synthesis

New vapour source materials are being synthesised for the deposition of $PbTiO_3$ insulating layers. The approach adopted is new and subject to a patent application. Lead acetate is dehydrated by boiling with methoxyethanol at 124-130°C. The solution cooled to 100°C and titanium alkoxide added slowly and the solution is again heated to 130°C to distil off the by-product, yielding gold-coloured liquid containing $PbTiO_2(OR)_2$.

$$Ti(OR)_4 + Pb(OCOCH_3)_2 \longrightarrow PbTiO_2(OR)_2 + 2CH_3COOR$$

As can be seen, this liquid contains all the required elements in one source and should provide a good route to $PbTiO_3$ by vapour pnase pyrolysis.

$$PbTiO_2(OR)_2 \xrightarrow[\text{Vapour}]{\text{Heat}} PbTiO_3 + (?OR)$$

Modifications of the alkyl group will be examined and initial products will be MOCVD tested within one week. Various homologues of $Ti(OR)_4$ are being synthesised to optimize for low deposition temperatures. Work on the dialkyl dithiocarbamates is continuing and complete analytical data for $Zn[(C_2H_3)_2NCS_2]_2$, $Zn(C_2H_3OCS_2)_2$ and $Mn[(C_2H_3)_2NCS_2]_3$ will be available shortly, and the compounds MOCVD tested for LPMOCVD and ASP produced ZnS.Mn thin films. The purification of the TCM manganese source is in progress and samples will be assessed by gas chromatography.

2.2.0 MOCVD Systems Development & Thin Film Deposition

2.2.1 LPMOCVD

Initial development work on the LPMOCVD rig is complete and the new low pressure TCM container has been tested. The first trial runs for the deposition of ZnS.Mn TF have been carried out and visual inspection under 365nm UV indicates a reasonable measure of manganese doping uniformity. At a later stage, quantitative manganese analyses will be made to fully calibrate the CVD system. Some peculiarities have been encountered concerning the state of; substrate surfaces (in the etched regions) that were not noticeable in previous atmospheric pressure work. This possibly suggests that

the deposition mechanism under reduced pressure is surface controlled, whereas it may be vapour phase controlled at atmospheric pressure. More attention will be given to substrate cleanliness and surface finish to eradicate this problem.

A modified source container has been constructed (Fig. 1) for improved deposition control. The heated enclosure is awaiting construction. This new 'plug-in' source chamber will allow us to reverse evacuate the CVD system and establish vapour flows prior to passage of the reactants across the hot substrates. On close-down, vapour flows can again be reversed to give an effective ON/OFF growth control.

2.2.2 ASP

Work on the construction of the horizontal multi-channel flow reactor described in the previous report has now been completed and initial trial thin film depositions for ZnS (from $Zn(C_2H_3OCS_2)_2$) and Al_2O_3 (from $Al(Acac)_3$) are in progress.

3.0 Deliverables

The samples of zinc sulphide manganese on conducting glass due on 31st January 1988 were despatched.

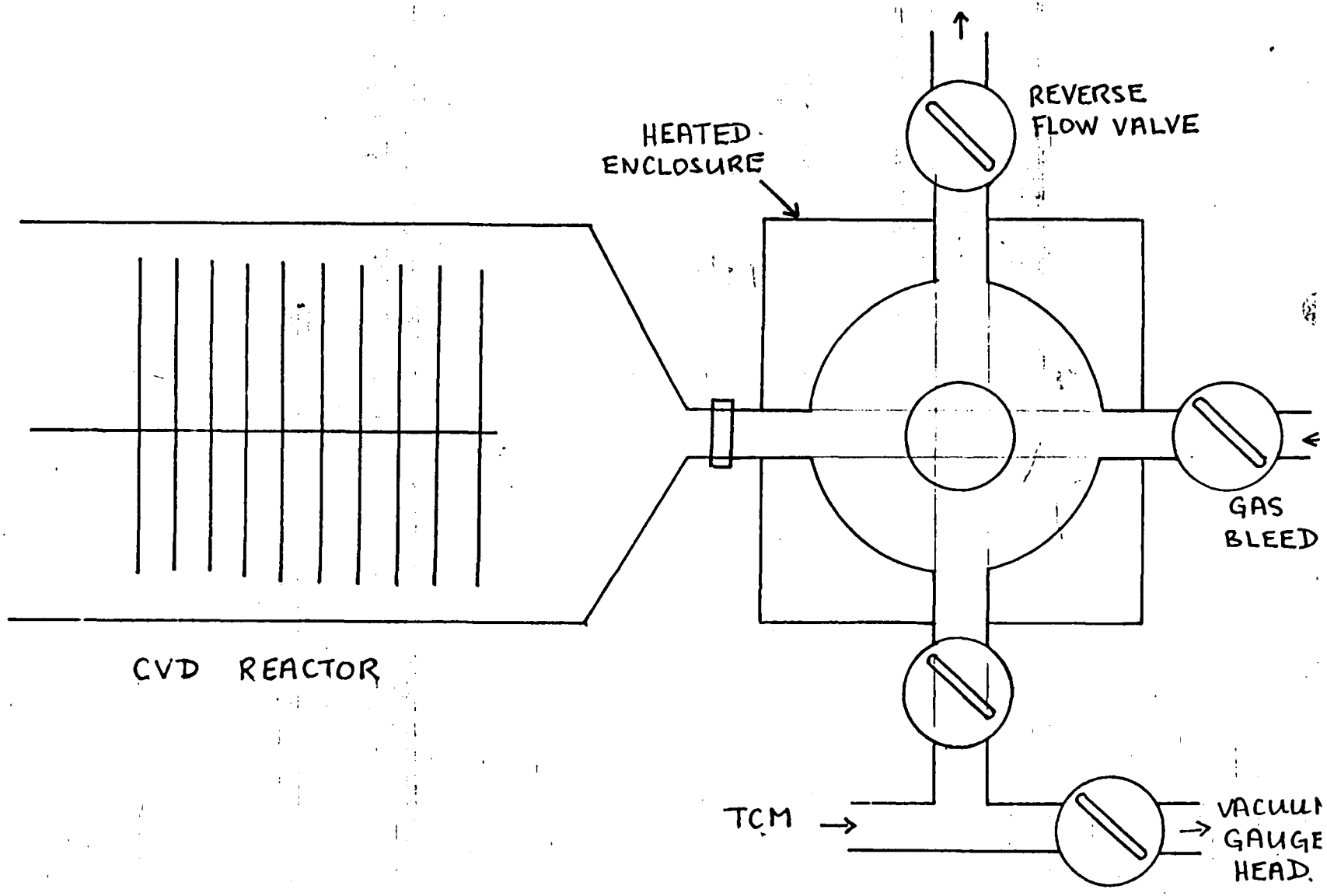

Fig. 1. Modified Source Container (plan view)

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