

“Thermoball™” Technology
The fittest Vacuum Evaporation Source and
The suited Effusion Cell for OLED

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1. Introduction

A pursuit and Continuity of perfection is to be our company philosophy.

At Vieetech Japan Co.,Ltd., our engineering teams have spent several months/ years for Vacuum Evaporation Source, and Effusion Cells for the OLED, as captioned above.

“Thermoball™” Technology is the best Technology for OLED materials to obtain inexpensiveness and efficiency without any thermal damage.

At the same time, we are also proud of the R&D success on Effusion Cell, the best suited, for the OLED Displays Mass Production Systems, based on our studies and experiences cultivated for Semiconductor Thin Film(Ga, In, As, P, Se, Al, Si, Ge etc.) over 20 years.

We call its technology “Thermoball” (named & registered), and we are confident it will make hence definitely great strides worldwide, and will be key in the OLED business.

Organic materials are complete different from Semi-Conductor/Metal-materials, namely :

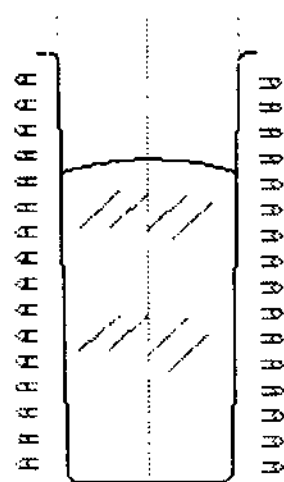
- Less thermal conductivity
- Remarkable weak for moisture
- Very high vapour pressure
- Easy & sensitive for thermal-damage

2. Progressive Steps on Effusion Cells :

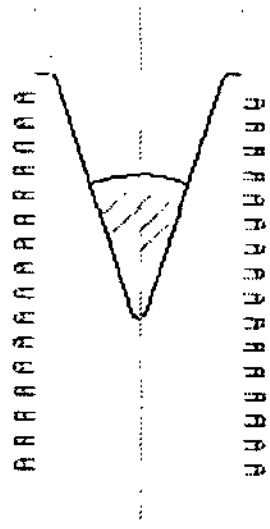
Each Drawing cited below shows each shape of crucible in a technical progress.

1) Straight-Wall/Cylinder type :

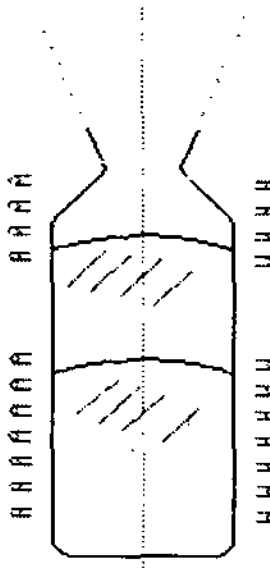
The original one is approx. 20 years old, apparently volumed capacity, but worse thickness uniformity.



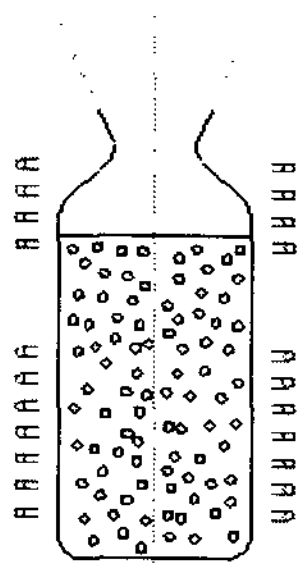
24.1 / Plenary



- 2) Conical type :
Better uniformity, but unstable flux beam due to a heavy tapered shape.

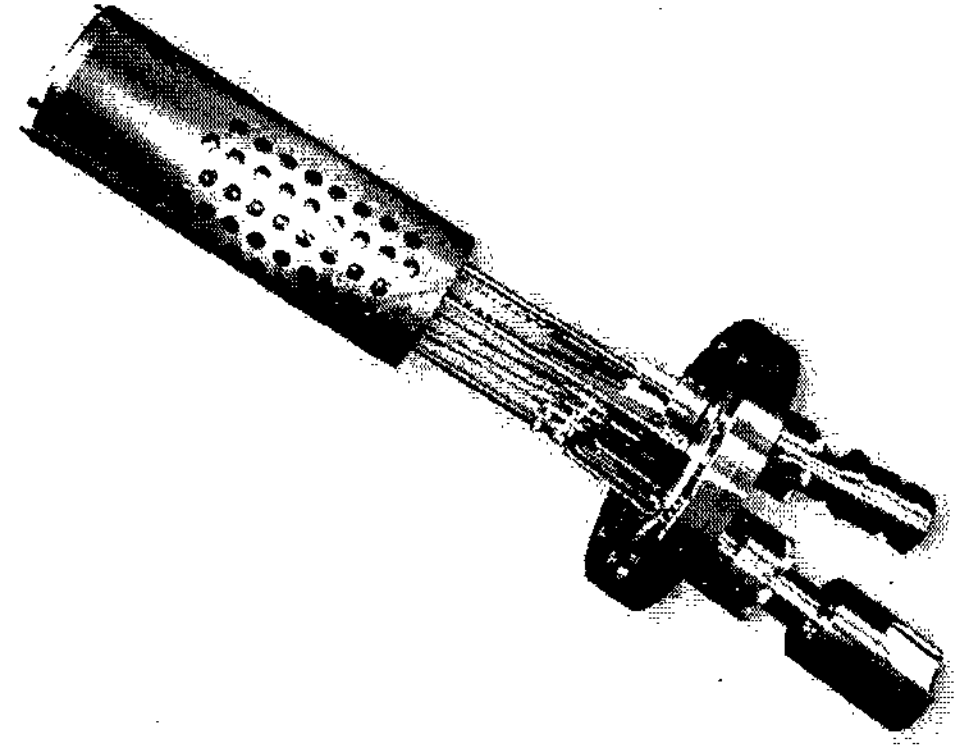


- 3) "SUMO"(waisted) type :
Patented in 1995 by Messrs. Applied EPI/MN.USA
Much improved to obtain : Stable crucible-pressure
: Stable flux beam
: Volumed cruciblecapacity
: Thickness uniformity



- 4) "Thermoball SUMO" type :
Developed in 2001 by VJ(Vieetech Japan) to register under "Thermoball" to obtain :-
: Superb heat conductivity
: Superb temperature uniformity
: Superb flux beam stability
: Superb economical material consumption

3. Application Notes (Features of "TSC"= Thermoball SUMO Cell) :



Extraordinary Notes :

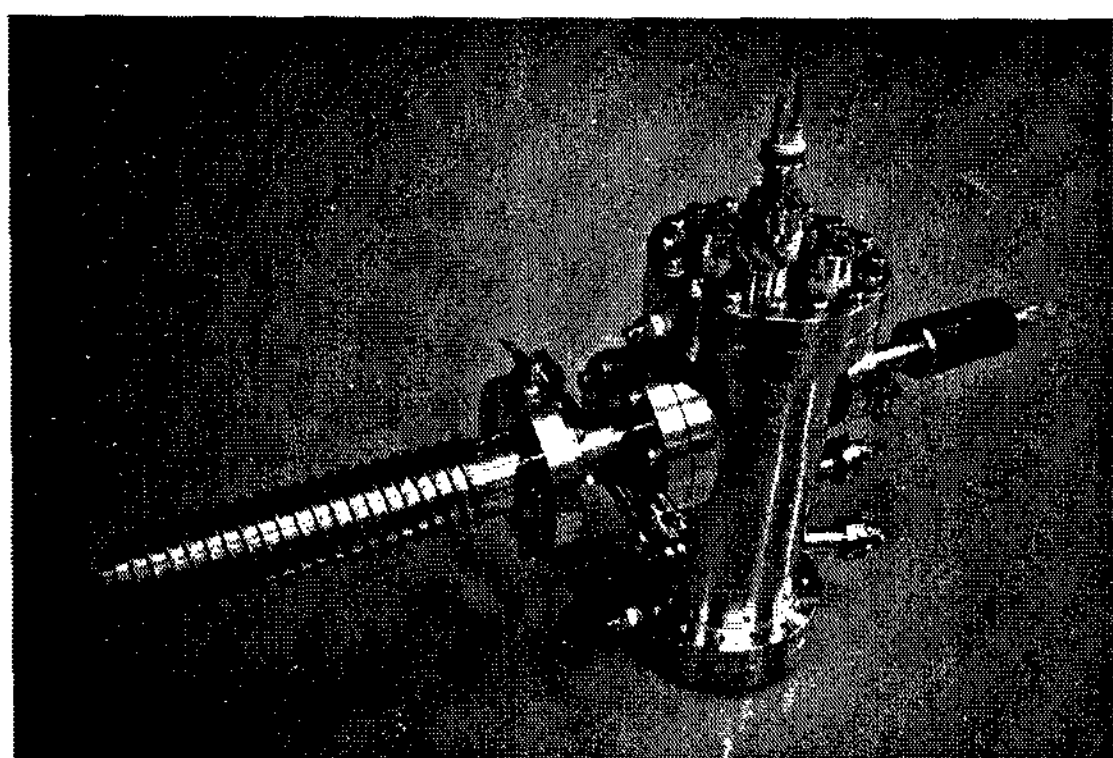
Mix the `Thermoball` materials(superb heat conductivity) into the OLED-materials(inferior heat conductivity) enabling them to obtain totally "Uniformity" in the crucible, concretely :-

- 1) Superior to flux beam & thickness uniformity.
- 2) No physical/chemical reaction on "Thermoball", even in high temp ($\sim 3000\text{ }^{\circ}\text{C}$) & UHV ($<10^{-10}$ Torr). This makes a virtual evaporated side unchanged, and keeps the flux beam stable enough.
- 3) Due to specific features by "Thermoball"/superb heat conductivity with smaller heat volume + with quick temp response, the flux beam intensity is well managed by the temp-control.

- 4) Due to superb "Thermoball", the crucible temp-accuracy (± 0.1 C) is constantly achieved, and also inexpensive material cost economically & efficiently is achieved.
- 5) Moreover, due to the superb outlet shape(insert), the deposition area is completely limited, and thickness uniformity ($\pm 5\%$) is satisfactory achieved.
- 6) Still moreover, due to the crucible temp-uniformity, material sublimating/ bubbling is smoothly & calmly proceeded, never on sudden bubbling.

4. Special Notes (Features of

"TVC" = Thermoball Valved Cell):



"TVC" is additively featured on "TSC".

- 1) Due to a large scaled crucible (>300 cc), a long operation continuously (>10 days) can be acceptable.
- 2) Due to a needle valve installed, a

linear control for flux beam intensity is achieved.

- 3) It is possible to set, as requested, a dynamic range of the flux beam intensity by a needle valve/crucible temp-control.

Also mixture with plural materials (<1%) can be possibly done.

- 4) In addition, due to a smaller outlet (crucible), a saturated pressure in the crucible is achieved, which automatically invites the flux beam diffusion uniformity & thickness uniformity.
- 5) Same features as mentioned above item 3-(2) can be repeated, i.e., no physical/chemical reaction on "Thermoball", even in high temp (~ 3000 °C) & UHV ($<10^{-10}$ Torr), and the flux beam intensity is controlled stable.
- 6) Same features as above 3-(4) is applied, i.e., the crucible temp-accuracy (± 0.1 °C) is constantly achieved, and inexpensive material cost economically & efficiently is achieved.
- 7) Same goes on above item 3-(5), i.e., sticking region is completely limited, and thickness uniformity ($\pm 3\%$, not 5%) is more satisfactory achieved.
- 8) Same as above 3-(6), i.e., material sublimating/bubbling is smoothly & calmly proceeded, never sudden bubbling.

5. Notes

The OLED in rapid progress is being watched with keen interest today in the world, and it has become widespread with recent advances day by day.

Vieetech has offered the unique range of breakthrough products for application to the OLED field.

Each of 'TSC' & 'TVC' as introduced represents the latest technology available commercially in the OLED market, particularly for Mass-Productivity.

We believe that our production will be the Key-parts for the OLED field