Changes to an IMC Evaporator during Aluminium Metalization

Michael Nürnberger
(Sintec Keramik GmbH)

ABSTRACT

There has been analysed an IMC 2-Comp evaporator after metallization with different analysing methods.

The chemical and physical changes of the outer surface and the interior 2-comp material will be presented.

Changes to an IMC Evaporator during Aluminium Metalization

Sintec Keramik GmbH
Michael Nürnberger
Ingenrieder Str. 2
D-86956 Schongau / Germany
Tel.: ..49(0)8861-2308-29
michael.nuernberger@sintec-keramik.com

1. ABSTRACT

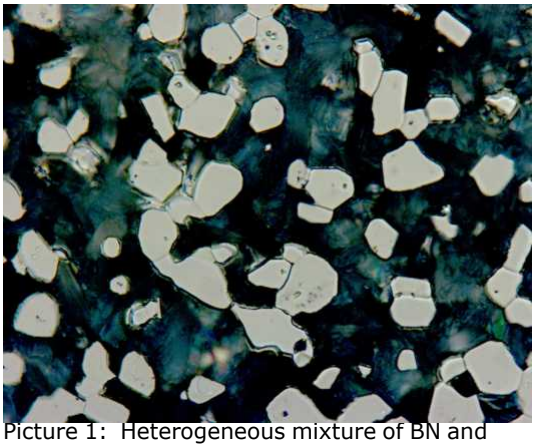
There has been analysed an IMC 2-Comp evaporator after metalization with different analysing methods.
The chemical and physical changes of the outer surface and the interior 2-comp material will be presented.

2. Introduction

IMC evaporator boats are visually changing the appearance during aluminium (Al) metalization. Main reason is the aluminium attack. Liquid aluminium is very aggressive and react therefore with the boron nitride (BN) and the titanium diboride (TiB2) of the IMC evaporator.
In longitudinal nearness to the wire fixing point the Al attack is very strong because of a high Al liquid-flow. That area gets deep grooves during Al metalization.
On the other hand there are step by step growing big, shiny crystals on the evaporator ends.
These material changes during metalization have an impact to the electrical resistivity of the evaporator. On the one hand the total electrical resistivity of the evaporator declines and on the other hand the resistivity distribution in longitudinal direction changes.

3. Starting Basis

An **Un**used 2-comp evaporator consists in approx. 65 **Vol**.% of Boron-nitride (BN) and 35 Vol.% Titanium-diboride (TiB_2).
Picture 1 shows an etched surface of an unused evaporator boat. The light coloured area shows TiB_2-particles, the dark area is BN.

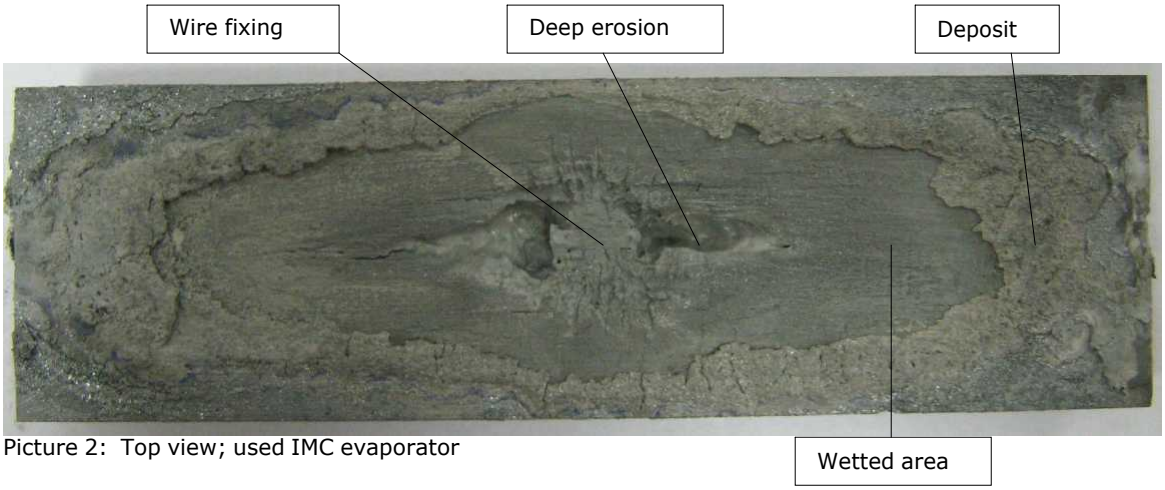


Picture 1: Heterogeneous mixture of BN and TiB_2 after hot pressing process

4. Analysis

There will be shown the analysis of the top side, bottom side and the cross section of an used IMC evaporator boat.

4.1. Analysis of the top side



Picture 2: Top view; used IMC evaporator

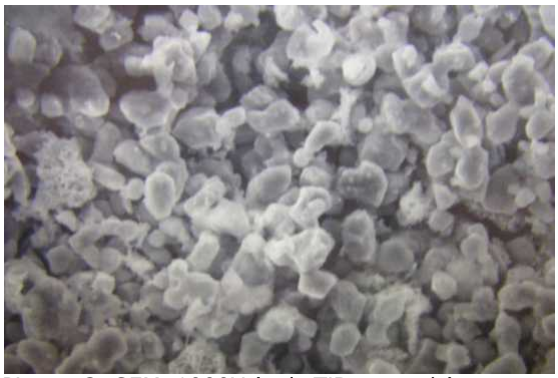
Results from XRD- and XRF-analysis:

Area	Compound		
	TiB_2	BN	AlN
Wire fixing point			x
Wetted area			x
Deep erosion area		x	
Deposit	x (80%)		x (20%)

AlN is generated by a reaction of BN with liquid Al and TiB_2 gets dissolved by liquid Al. Therefore AlN is the predominant compound on the top side of an used IMC vaporator. The dissolved TiB_2 re-crystalize on the evaporator ends and build up the deposit.

4.2. Analysis of the bottom side

Picture 2: Cbottom side; used IMC evaporator



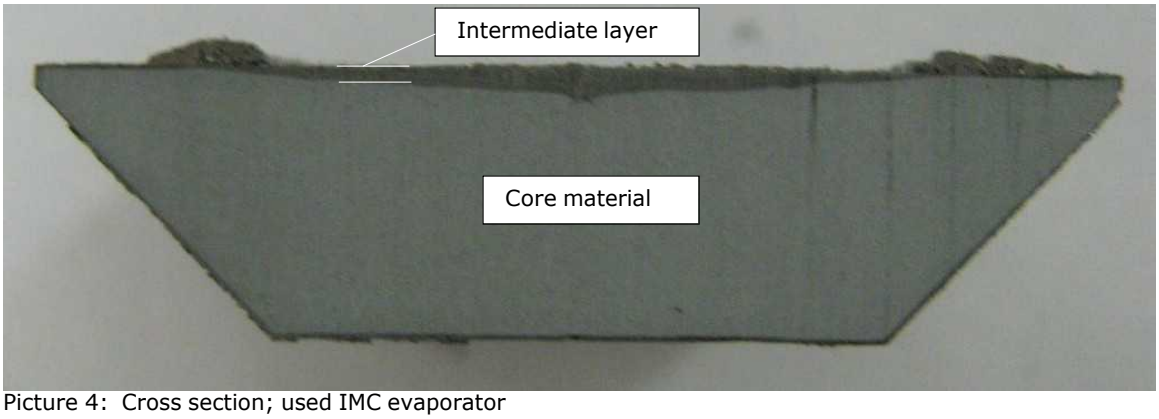
Picture 3: SEM, 1000X (only TiB_2-crystals)

Results from XRD- and XRF-analysis:

Area	Compound		
	TiB_2	BN	AlN
Bottom side	x		

BN gets decomposed at predominat metalizing conditions (>1300°C; 10^{-4} mbar), TiB_2 remains then on the bottom side.

4.3. Analysis of the Cross Section



Picture 4: Cross section; used IMC evaporator

4.3.1. Intermediate Layer
During Al-metalization there is built up an intermediate layer, consisting of aluminium nitride (AlN). That AlN is generated by the reaction of BN with liquid Al. AlN is stable against any further Al-attack and it´s also stable against decomposition in case of an excess of aluminium. That intermediate layer is a passive layer protecting the virgin 2-comp material from any further reaction. AlN is an electrical insulator.

4.3.2. Core Material
The core material itself keeps almost unchanged. There could detected only a slow decrease of the calzium borate binder phase which have no bad influence to nothing.

4.4. Electrical Properties

The 2-comp IMC core material does almost not change specific electrical resistivity. There could be measured only very slow changes (unused => used evaporator) in specific cold and hot restsivities.

But there is a deep impact of the deposit to the resistivity:
A **reduced** cold resistivity can be measured if the residual deposit keeps on the boat.

If there is removed the residual deposition near the evaporator ends the cold resistivity increase 15-20% with regard to the uncleaned boat.

The cold resistivity after cleaning is closed to the cold resistivity of the unused boat then.

Therefore evaporator boats should be cleaned on the top side after each metalizing cycle.

5. Summary

- ⇨ The **removal** generate a **declining electrical resistivity** for "boats in use".
- ⇨ The 2-comp IMC **(core)material** does **not change** spec. resistivity
- ⇨ The **AlN rich intermediate layer** works as a **passive layer** preventing further attack against the virgin 2-comp evaporator boat material.
- ⇨ The **"weak" component** with regard to chemical resistance is **TiB_2**