TEST NOTE

To: Dr PSJ Halliday	**From:** H C Bezuidenhout
Test Note Number: IS-053-09	
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Reference: TPSi 20µm high resistance bridge wire Sensitivity – Principle Evaluation	
Material: Porous Silicon	
Source: R&D	
Authorised for release: Dr M W Taylor **Signature: MikeTaylor** **Date: 22 December 2009**	

TITLE

Initiating Treated Porous Silicon with a 20µm high resistance fuse head bridge wire

1. INTRODUCTION

Porous silicon treated with PETN detonates when exposed to hot surfaces (+ 145 ºC). Porous silicon (PSi) treated with sodium perchlorate can also be ignited by electric bridge wire as reported by Vesta Sciences.

In this evaluation three different samples of porous silicon were treated with PETN. The silicon samples evaluated were from Vesta Sciences and Intrinsiq. Two of the silicon samples from Intrinsiq were prepared by two different methods.

The treated porous silicon was then applied into the fuse head header containing a 20µm bridge wire fuse head.

Two different methods of applying the treated porous silicon onto the fuse head, in the header, were also evaluated.

The fuse heads coated with the porous silicon were then tested for functionality only.

2. AIM

The aim of this evaluation is to determine if porous silicon, treated with PETN, can be initiated with a standard 20µm high resistance bridge wire fuse head.

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	Signed:Henco Bezuidenhout

3. EXPERIMENT

Three different PSi samples (table 1) were used in this evaluation.

Table 1: PSi sample description.

Supplier	Description	BET Surface Area (m^2/g)
Vesta Sciences	20081120	192
Intrinsiq	Etched	190
Intrinsiq	Anodized	250 - 300

Note: Values were provided by Vesta Sciences and Intrinsiq respectively

The fuse heads headers were filled using two different methods. The first method entailed making a porous silicon paste. The headers were then filled with the paste ensuring that the bridge wire of the fuse head is completely covered with the paste.

The second method used entailed filling the fuse head headers with porous silicon. A saturated solution of PETN in acetone was then dripped onto the porous silicon in the header.

3.1. Preparation of porous silicon paste

The following method of preparation was used:

- a saturated solution of PETN in acetone was prepared,
- the PSi was weighed on a balance,
- the PSi was wetted with 250µl (using a micro pipette) of the saturated PETN solution,
- the paste was then dripped into the fuse head cup

The different porous pastes prepared are described in table 2.

Table 2: Porous silicon paste - description.

PSi sample	PSi mass (g)	PETN mass (g)*	TPSi mass (g)	Psi : PETN
Vesta Sciences 20081120	0.0457	0.023	0.0687	1.99 : 1
Intrinsiq - Etched	0.0694	0.023	0.0924	3.02 : 1
Intrinsiq - Anodized	0.0589	0.023	0.0819	2.56 : 1

**** 50µl of the saturated PETN solution contain 0.0046g PETN***

3.1.1. Fuse head filling

The fuse head was filled with the PSi paste (using a micropipette) and left to dry at ambient temperature.

3.2. Preparation of porous silicon – dry filling

The following method of preparation was used:

- the fuse head header was filled with PSi (constant volume),
- the PSi were weighed on a balance,

- using a micro pipette, the PSi in the fuse head header, was wetted with the saturated PETN solution,

The different formulations prepared are described in table 3.

Table 3: Porous silicon - dry filling description.

PSi sample	PSi mass (g)	PETN mass (g)	TPSi mass (g)	Psi : PETN
Vesta Sciences 20081120	0.0259	0.0131	0.0390	1.97 : 1
Intrinsiq - Etched	0.0417	0.0122	0.0539	3.42 : 1
Intrinsiq - Anodized	0.0297	0.0132	0.0429	2.25 : 1

3.2.1. Fuse head filling

The header was filled with dry PSi. The dry PSi was then dosed with the saturated solution of PETN in 50µl increments. The fuse head was left to dry at ambient temperature.

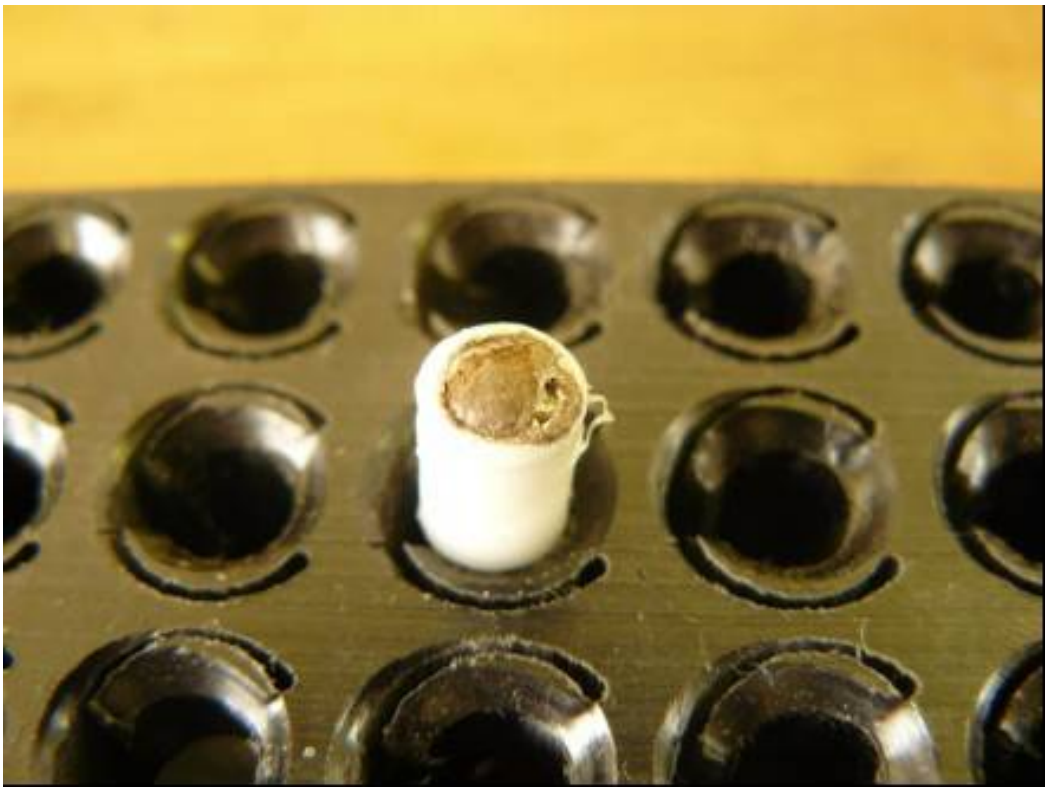

Figure 1: Fuse head header filled with Dry PSi and then dosed with PETN

3.3. Functioning evaluation

The TPSi filled fuse heads were evaluated for functioning using a fuse head tester. The test fuse heads were positioned in the tester and initiated. The reaction was observed both visually and audibly.

4. RESULTS

The functioning results obtained are given in table 4.

Table 4: Fuse head functioning results.

PSi sample	Filling method	Functioning
Vesta Sciences 20081120	TPSi Paste	Detonation
Intrinsiq - Etched	TPSi Paste	Detonation
Intrinsiq - Anodized	TPSi Paste	Detonation
Vesta Sciences 20081120	Dry dosing	Detonation
Intrinsiq - Etched	Dry dosing	Detonation
Intrinsiq - Anodized	Dry dosing	Detonation

5. DISCUSSION

Both methods of filling the fuse head produced fuse heads that functioned when initiated by the fuse head tester. Both methods seem to produce TPSi with comparable PETN / PSi ratios. A mass difference was however noted.

The Dry Filling method produced a total dry TPSi mass that is about 45% lighter than its dry Paste filled counterpart. A difference in the filled volume of the fuse head cup was hardly noted. A filled density difference can thus be assumed.

6. CONCLUSIONS

From the evaluation conducted it can be concluded that:

- Treated Porous silicon can successfully be filled in a fuse head header using both the dry fill and paste fill methods,
- Both filling methods produced detonation results,
- All the silicon samples evaluated produced detonation results.

7. RECOMMENDATIONS

From this evaluation it is recommended that:

- This study is pursued to formally develop a porous silicon based mixture that can reliably be initiated by a 20 μm high resistance bridgewire fuse head.