Subject: Materials for use in cryogenics
Posted by annefreerk on Tue, 11 Jun 2013 17:27:00 GMT
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I am currently designing a sample holder that will be used in liquid helium.
Has anyone experience with exposing 3D printed materials to low temperatures? Generally, the CTE is important which is rather large for most plastics. Maybe the alu filled nylon might work? Just wondering if anyone has experience with this.

Anne

Subject: Re: Materials for use in cryogenics
Posted by Arnaud3D on Wed, 12 Jun 2013 09:15:58 GMT
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Nylon and cold don't go well together, looses its elasticity and becomes fragile. What's wrong with a stainless steel material for your application ? SS goes very well with lowtemp such as liquid helium.

Subject: Re: Materials for use in cryogenics
Posted by rouwkema on Wed, 12 Jun 2013 10:45:09 GMT
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Apart from that, I think you do not want a porous material. Liquid gas trapped in the pores could easily lead to an exploding sample holder if the gas expands.

Subject: Re: Materials for use in cryogenics
Posted by annefreerk on Wed, 12 Jun 2013 15:50:56 GMT
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Ok, looking at the material density there is probably not a very high aluminum dust content so this is not likely going to attribute much to the CTE. There is also some strength needed so stainless steel might be a better way to go, I just wanted to explore the least expensive option first..

Subject: Re: Materials for use in cryogenics
Posted by annefreerk on Wed, 12 Jun 2013 15:58:28 GMT

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Good point about the porosity. It seems that stainless steel is watertight, not sure how it behaves with liquid helium.
Is it annealed to have the bronze fused with the stainless steel?

Subject: Re: Materials for use in cryogenics
Posted by lensman on Tue, 18 Jun 2013 18:09:26 GMT
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While the s/steel here may be watertight I don't know that I would be sticking it in liquid helium. The printing process (I could be wrong here) leaves microscopic tunnels of empty space. It's been a loooong time since I was in a lab but I don't think that's a good thing.

Subject: Re: Materials for use in cryogenics
Posted by annefreerk on Wed, 19 Jun 2013 18:16:54 GMT
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I think the problem is with the expanding of the liquid when taken out of the cryostat and going to vapor state. However, the material should be strong enough to withstand that, I'd imagine.
Does anybody actually have a density number for printed stainless steel? That may give an indication of porosity.

Subject: Re: Materials for use in cryogenics
Posted by FreeRangeBrain on Wed, 19 Jun 2013 18:26:11 GMT
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As someone with an abiding interest in, but little access to, scientific laboratories, it would be interesting to see a sintered stainless specimen "seething" liquid helium.

Subject: Re: Materials for use in cryogenics
Posted by Arnaud3D on Fri, 05 Jul 2013 07:59:19 GMT
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To avoid this "microcracks" in the SS you can always try to apply a heat treatment on the part and

polish it as much as possible. I am following some mechanical tests on different 3D printed metal alloys and the data are completely different if after manufacturing treatments are made on the part.
I am not saying this will make the part completely liquidproof, just an idea.

Subject: Re: Materials for use in cryogenics
Posted by annefreerk on Fri, 05 Jul 2013 15:38:07 GMT
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Thanks for the advice, I can imagine heat treating has major impact on metal properties.
In the end, I discovered that the SS is magnetic, which makes it unfit for our purposes; I have ordered the part in aluminum from incodema.