# A theory of how the WE diamond pastes work

Posted by mark76 - 01 Apr 2012 15:06

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When I first saw Tom's microscope photographs of the edge of a knife after stropping with the 14 micron and 10 micron diamond pastes I was baffled. I was it again when I was able to repeat this myself. Even though the edge got very smooth and sharp, there were only tiny scratches caused by the pastes. How could pastes that were so little abrasive create such smooth edges, both on balsa and on leather?

I did some additional experiments and a bit of thinking. I think I now know why it was so difficult for me to comprehend how the diamond pastes work: I was trying to explain what I saw through the microscope in terms of assumptions I held about why stropping with the diamond compounds worked:

- Leather has a stiction that causes it to burnish the edge, i.e. smear out metal over a larger area that causes scratches to become less wide and less deep or sometimes even to disappear.
- The diamond pastes are abrasive because they remove metal by making lots of scratches with a width and a depth of their specified micron size (or a little lower, since only a part of every diamond particle would touch the edge).
- The diamond pastes work on leather due to the dual effects of burnishing and abrasion.
- The diamond pastes work on balsa due to abrasion.

Tom had already shown that the second assumption was likely not true. It dawned on me when I saw with my own eyes that the first assumption was not true either. The additional experiments and thinking showed that all four assumptions are wrong!

Yet these pastes do work. So I tried to come up with an alternative explanation. You can read it in full on my blog
. But in short I think the following is happening:

- Both the balsa and the leather strops are hardly abrasive by themselves. They do not cause much burnishing by themselves either.
- The strops become effective when loaded with the diamond pastes.
- The diamond pastes cause a lot of burnishing, but hardly any abrasion.

It is the pastes that do the work, not the strops. And these pastes are hardly abrasive, but have a strong burnishing power.

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## Re: A theory of how the WE diamond pastes work
Posted by wickededge - 12 Apr 2012 08:20

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The kangaroo and naon-cloth are shocking, really. 🙂

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## Re: A theory of how the WE diamond pastes work
Posted by PhilipPasteur - 12 Apr 2012 09:01

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Yes the Roo and Nano cloth are pretty amazing stuff for sure. We have seen differences in stropping media, but these are at least an order of magnitude better.

Another thing that I found interesting and maybe a bit disapointing was how comparatively rough the Chosera 10K stone left the blade. As Tom might say, "from the macro level" this stone leaves a real mirror finish. We have discussed the limitations of our cameras, and I am sure it is all in my technique with the Veho, but I never would have guesssed, nor have I seen, the level of scratches being left by that stone.

Additionally this series of photos really turns a bunch of the common wisdom on stropping on its ear. What are considered to be the best stropping media around just flat are amazingly abrasive on their own.

It is just counterintuitive that soft "smooth" leather or balsa can scratch hardened steel like they apparently do.

Again, great stuff Clay!

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## Re: A theory of how the WE diamond pastes work
Posted by razoredgeknives - 12 Apr 2012 10:00

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Wow, those edges are sweet! Count me in for an order... This may be what I've been looking for. I got an edge on a razor to pass the HHT, but it was holding the hair really close to the edge. Then when I went from the .25um paste (Norton) to the .125um spray I lost the HHT capability... was really weird. Looking forward to getting some of that stuff! Probably too early to tell, but which would you prefer Clay, nanocloth or kangaroo leather? Which one is easier to mount to one of the normal strop paddles? (i.e. I will remove the leather from the ones I have and replace it).

Awesome work bro... keep it up. Looking forward to seeing pics w/ your new microscope, lol!!! Did you see the thread a while back where someone had posted a link to another forum where a guy had a 1000x microscope that he could take pics with? You should just pull the trigger and get one... you know you will have one eventually anyway, haha!

Edit: its called a metallograph... here's the thread , check out those edge pics! Unfortunately, they're real expensive... $1700-$1800!!!

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## Re: A theory of how the WE diamond pastes work

Posted by wickededge - 12 Apr 2012 10:10

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I am really impressed by the super smooth polish I got from the Roo and Nano-Cloth. That said, the smoothness doesn't necessarily translate into either performance or durability for all cutting tasks. The blade did best at the HHT after the plain cow top grain and the plain horse butt top grain. As far as the 10k stone goes, I'm still a big fan - my thinking on it is this: if you want a great cutting edge, then 10k, or 1.74um is an extremely well rounded level of finish and the uniformity of the Chosera scratch pattern is exceptional, plus the path to get there is short. I went straight from the 1600# ceramics to the 5k/10k combo and was at that level within just a couple of minutes. As far as the scratches go, the 10k is nearly 7x as coarse as the .25um strops on roo leather, so we're getting about what we should expect and it's hard to overstate the necessity for some micro-teeth, ideally perfectly formed, uniform micro-teeth. After all this, I find myself wanting to do a massive cutting comparison of identical blades with different finishes! What I'd really like to do is develop a matrix that helps us to pinpoint exactly which finish is best suited for a given application both from a performance standpoint and from a durability standpoint. Another big factor is ease of maintenance. I think a lot of the fun of the Wicked Edge platform at this level is the ease with which one can experiment and contemplate the exact best geometry and finish to apply to a given knife. Lots to explore...

**PhilipPasteur wrote:**

Yes the Roo and Nano cloth are pretty amazing stuff for sure. We have seen differences in stropping media, but these are at least an order of magnitude better.

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Again, great stuff Clay!

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## Re: A theory of how the WE diamond pastes work

Posted by mark76 - 12 Apr 2012 10:11

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## Re: A theory of how the WE diamond pastes work

Posted by wickededge - 12 Apr 2012 11:06

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I had a lot of that going on, pass/fail, pass/fail on the HHT with the various strops. The ones that did the best by far were the horse butt top and cow top.

**razoredgeknives wrote:**

Looking forward to getting some of that stuff! Probably too early to tell, but which would you prefer Clay, nanocloth or kangaroo leather? Which one is easier to mount to one of the normal strop paddles? (i.e. I will remove the leather from the ones I have and replace it).

Both mount the same - they're coming from Ken already affixed to aluminum blanks, so you just peel back the cover on the tap, press on and you're done. It's too early to decide between the two, have to do LOTS more testing. ☺

**razoredgeknives wrote:**

Awesome work bro... keep it up. Looking forward to seeing pics w/ your new microscope, lol!!! Did you see the thread a while back where someone had posted a link to another forum where a guy had a 1000x microscope that he could take pics with? You should just pull the trigger and get one... you know you will have one eventually anyway, haha!

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## Re: A theory of how the WE diamond pastes work

Posted by razoredgeknives - 12 Apr 2012 11:49

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**wickededge wrote:**

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lol, yeah... pocket change for ppl like you w/ big money!!

So did you try the HHT at each step w/ the kangaroo/nano cloth as well? Theoretically it should work better you would think... unless it is like you propose, that there is a happy medium where you have a bunch of micro serrations that are highly polished that will "grab" the hair and lop it off... the normal rule of thumb seems to be the higher the polish, the easier the HHT will be... may be a faulty assumption!

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## Re: A theory of how the WE diamond pastes work

Posted by holymolar - 12 Apr 2012 13:33

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What is HHT?

Horse Hair Top?

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# Re: A theory of how the WE diamond pastes work

Posted by KenSchwartz - 12 Apr 2012 13:46

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Clay, I have to compliment you on doing some OUTSTANDING work demonstrating the capabilities of Nanocloth and Kangaroo.

I also want to make the point that using the WEPS platform to do this testing is a match made in heaven and a testament to what precise sharpening is all about!

Those micrographs are STUNNING and demonstrate beautifully what I've been saying about these compounds and strops and the importance as you get finer compounds of the effects of the substrate on masking the effects of the compound.

I hope you don't mind if I quote your work and use these pictures elsewhere to further promote your work and the products on the WEPS platform.

I could more obviously see that getting a 'pure effect' or compound only effect was critical at the higher grit levels like eighth and tenth micron snd finer, but your quarter micron pics strongly suggest that the nanocloth and 'roo may have additional benefits at even lower grits, possibly well below 1 micron. So I'm anxiously looking forward to the additional work on the coarser compounds I sent you with the additional nanocloth samples.

Using a surface that is smooth beyond the limits of light microscopy as a starting point for demonstrating other abrasive preps like the 10k Chocera is also a SUPERB way to demonstrate the scratch pattern of that stone without the confusion of residual coarser scratches. Again NICELY Done!!

Now when we go beyond eighth micron down to 0.025 microns we are talking about a particle the size of a small virus, so I suspect that the resultant scratch pattern will also be beyond the limits of ANY light microscope. Yet we may well see some differentiating characteristics in the way the light gets reflected from these surfaces using your current equipment. Something like the effect that you see using an ultrafine graticule as a prism (just wildly speculating here about what to look for) like you see doing spectroscopy. Perhaps a high resolution mirror effect visible at full magnification. Can't wait to see the results!

Very exciting work, Clay!

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Ken

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## Re: A theory of how the WE diamond pastes work

Posted by leomitch - 12 Apr 2012 14:00

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+1!!! My mouth is hanging agape with awe at what the 'Roo and Nano cloth did Clay! Startling microphotographs! I got to get me some of that Roo and Nano-cloth!

Leo

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