# Adaptive Smoothing for DSC and TGA

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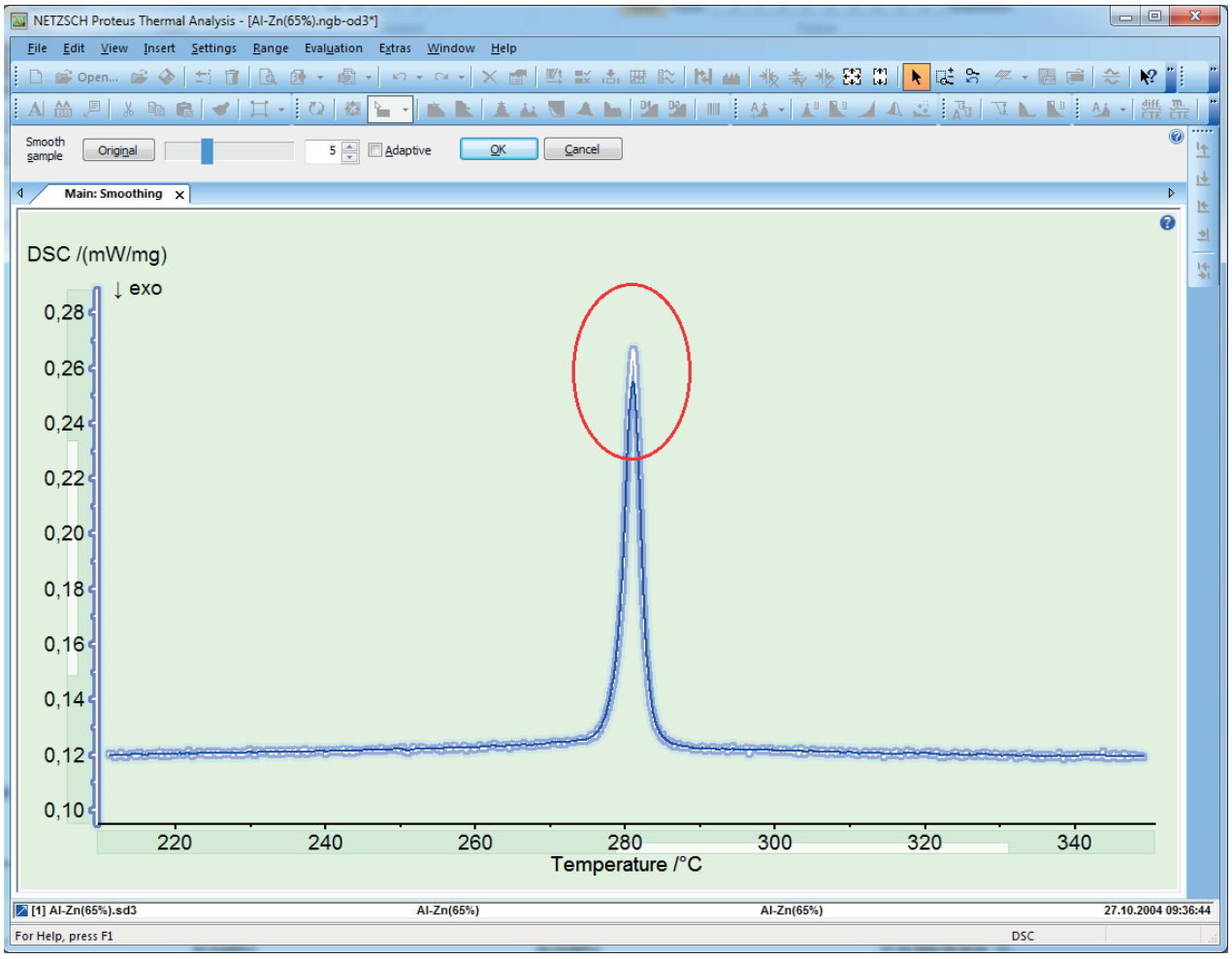
Proper smoothing of thermoanalytical data is a challenge for decades. A common drawback of conventional smoothing is illustrated in figure 1 where DSC data is smoothened at a level* of 5 in order to reduce the noise before and after the peak. However, the peak height is reduced which is an artifact due to smoothing.




**1** Conventional smoothing of DSC data in *Proteus*® analysis at a smoothing level of 5. The white curve represents the original DSC data, the blue curve the smoothened DSC data (see text).

*In *Proteus*® analysis version 7.2 or higher, smoothing levels in the range 1…16 can be selected representing the smoothing levels formerly designated as 1…8, A…H.

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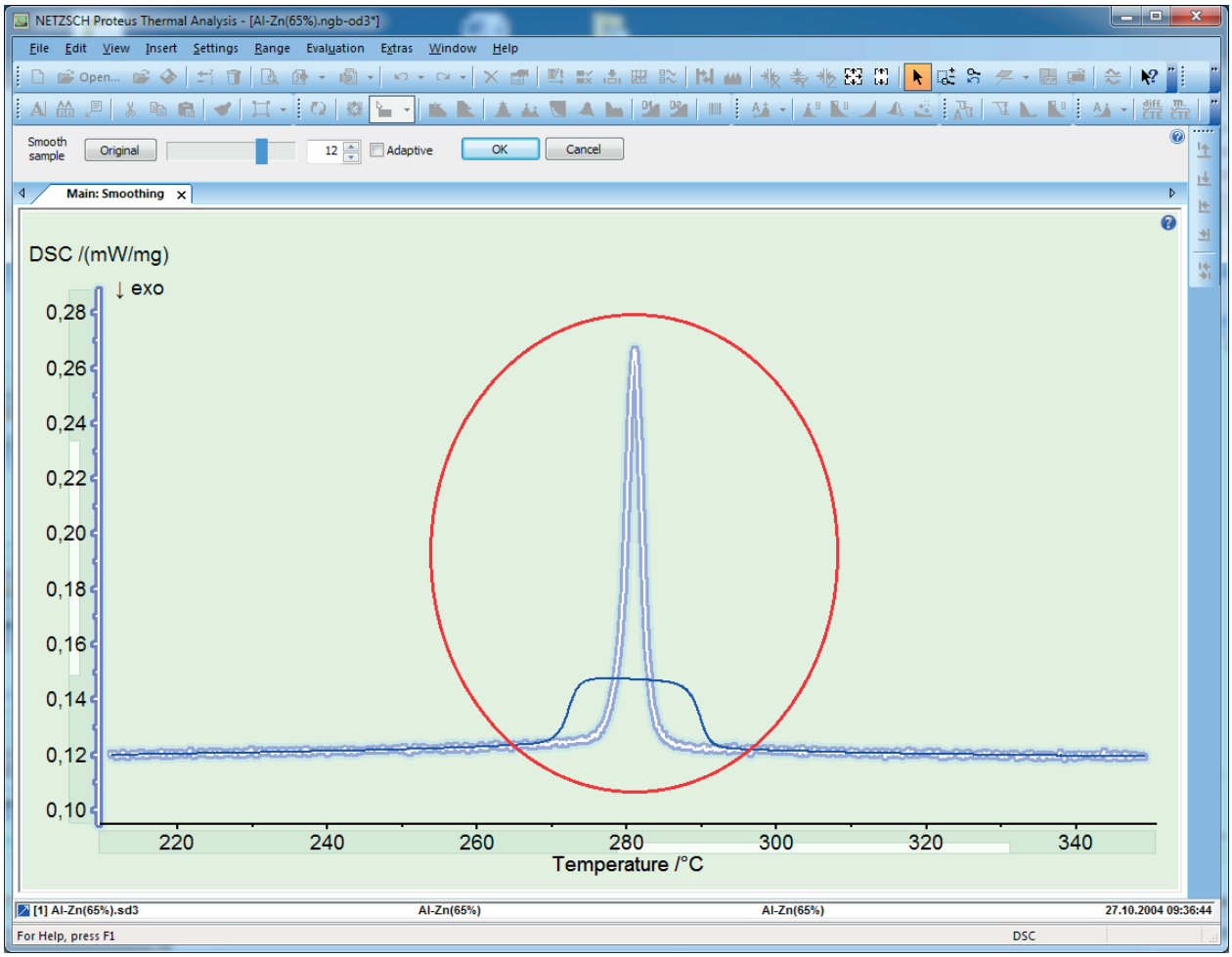
At a higher smoothing level of 12, the DSC peak is even more smeared by smoothing (see figure 2). This effect is caused by the wide interval in which the data are averaged at high smoothing levels. As a consequence, a user so far had to choose a sufficiently low smoothing level in order to not falsify caloric effects originating from the sample.




**2** Conventional smoothing of DSC data in *Proteus*® analysis at a smoothing level of 12. The white curve represents the original DSC data, the blue curve the smoothened DSC data (see text).

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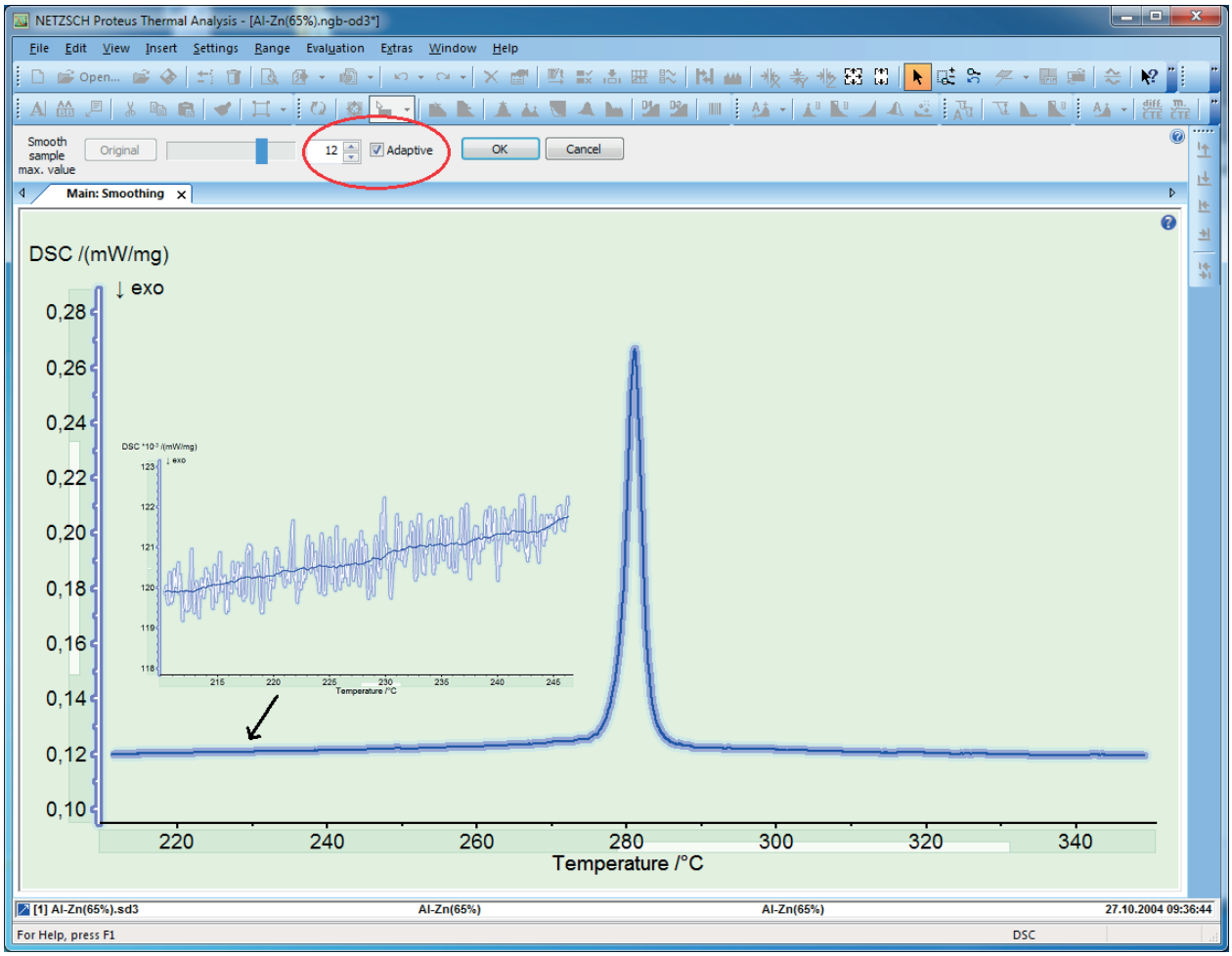
This situation is considerably improved by the novel Adaptive Smoothing available in *Proteus*® analysis version 7.2 or higher. Adaptive Smoothing can be activated via the checkbox "Adaptive" within the usual smoothing user interface (see figure 3). As a result, the DSC data is smoothened at the selected level only in regions where no DSC peaks occur, whereas the smoothing level is decreased automatically at DSC peaks. Thus, DSC peaks are not altered. The applied smoothing level is obviously flexible – in contrast to conventional smoothing where it is constant for all data points. Of course, Adaptive Smoothing does also work for DSC curves exhibiting several endo- or exothermic effects. Applying Adaptive Smoothing, the signal-to-noise ratio of the exemplary data shown in figure 3 is increased by about one order of magnitude.




3 Adaptive smoothing of DSC data in *Proteus*® analysis at a maximum smoothing level of 12. The white curve represents the original DSC data, the blue curve the smoothened DSC data (see text).





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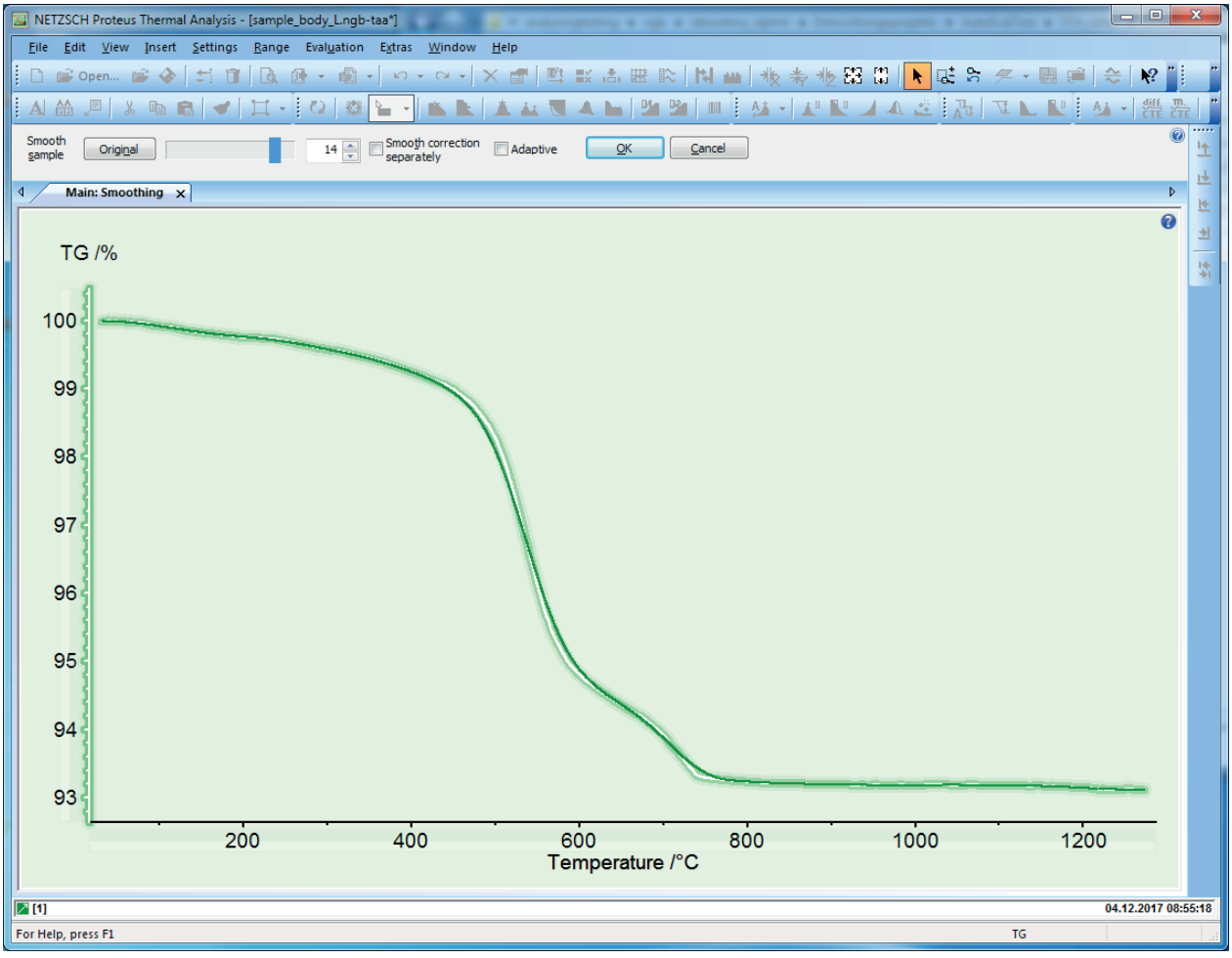
Figures 4a and 4b illustrate that Adaptive Smoothing can also be applied for TGA signals – either from TG or from STA instruments. In case of conventional smoothing at a high smoothing level of 14 (see figure 4a), the mass-loss steps are smeared – in contrast to the curve where Adaptive Smoothing was used (see figure 4b).

Adaptive Smoothing reduces the smoothing level during significant mass changes, while the maximum smoothing level is applied in regions where no mass changes occur. Again, Adaptive Smoothing allows for high maximum smoothing levels that are generally not recommended in case of conventional smoothing.




**4a** Conventional smoothing of TGA in *Proteus*® analysis at a smoothing level of 14. The white curve represents the original TGA data, the green curve the smoothened TGA data (see text).





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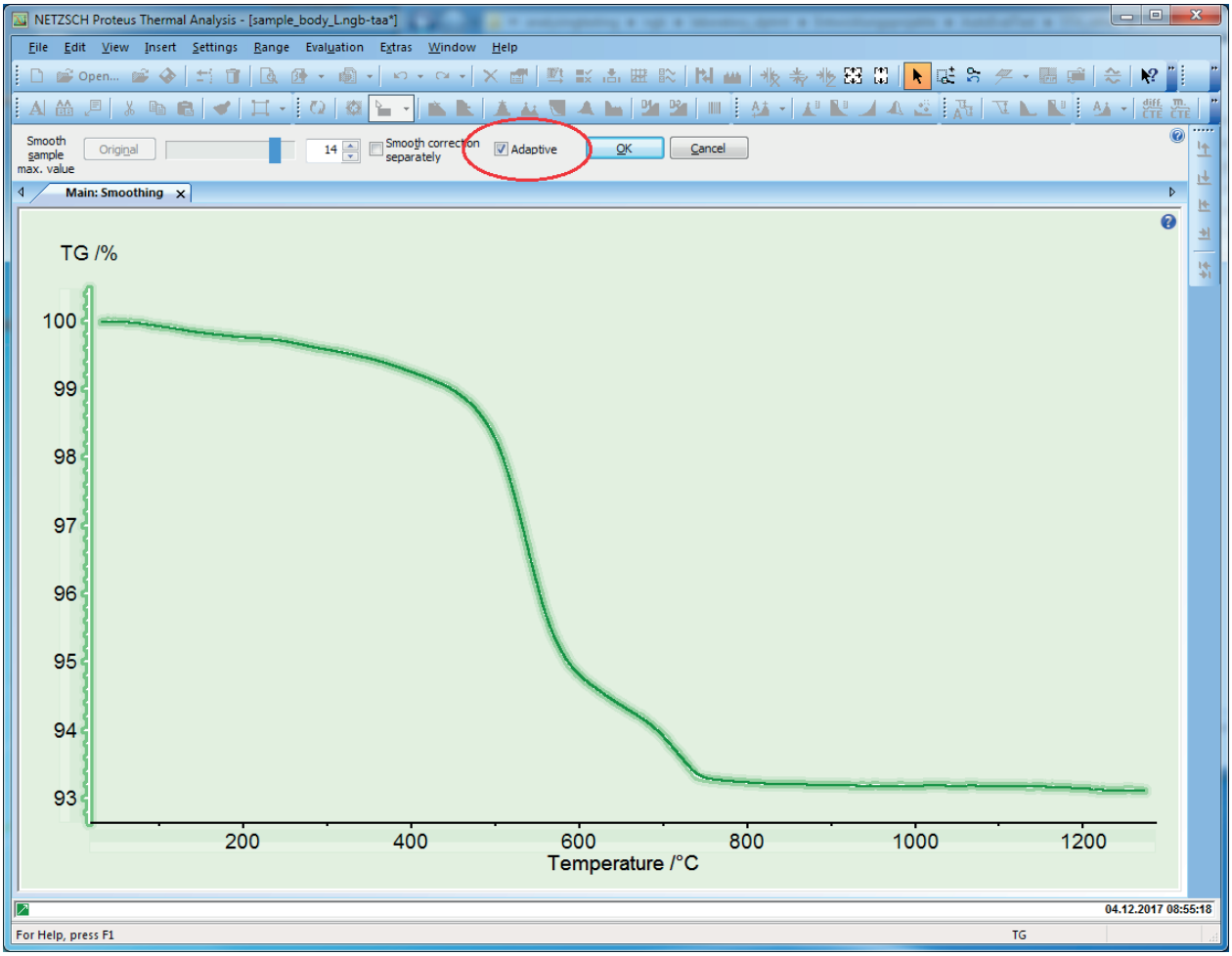


**4b** Adaptive smoothing of TGA in *Proteus*® analysis at a maximum smoothing level of 14. The white curve represents the original TGA data, the green curve the smoothened TGA data (see text).

In summary, the novel Adaptive Smoothing automatically adapts the smoothing level within a measurement in such a way that DSC peaks or mass changes (detected via TGA) are not falsified – even at high maximum smoothing levels applied.

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