

## Introduction:

Hair is an important feature that defines an individual's personality. Growing hair fashion trends dictate that people repeatedly subject their hair to mechanical, heat and chemical treatments including combing, heat-ironing, coloring/bleaching to achieve their desired look. These grooming practices can abrade the cuticle and degrade the internal hair structure by fatigue or chemical means resulting in tactile and structural changes, cumulatively perceived by consumer as damage. Damaged hair lacks structural integrity, breaks easily and is aesthetically less appealing<sup>[1-4]</sup>. Hair damage is a non-reversible process through physiological repair mechanisms and cosmetic interventions are, therefore, required to address the symptoms. The present study establishes the damage repair and protection credentials of technologies, namely Keratin Actives (KA) and silicone, delivered through a shampoo and conditioner system. Keratin Actives are small molecules that penetrate deep within the hair fiber<sup>[5]</sup> and have been shown here to restore and strengthen the internal protein structure using Differential Scanning Calorimetry (DSC). The presence of silicone technology within the system has been shown to contribute to surface repair of the damaged hair and to lubricate the hair surface and enhance the tactile characteristics providing surface repair and protection.

## Materials and Method:

The Shampoo and Conditioner was evaluated on virgin hair, bleached hair and hot-ironed hair. A Mettler Toledo DSC 1 StarE System was used to measure the denaturation temperature of hair protein as a measure of internal damage and the repair efficacy of the Keratin Actives. The strength of the hair fiber was assessed as a function of hair breakage when subjected to repeated combing cycles using custom hair combing rig (HCR). The hair surface repair was also evaluated using Scanning Electron Microscope (SEM) FEI Quanta 200. A modified Texture Analyzer (TA), manufactured by Stable Micro Systems, was used to evaluate tactile/smoothness of hair fiber.

## Results & Discussion:

### Differential Scanning Calorimetry (DSC)

DSC has been used here to determine the protein denaturation temperature of the hair. A higher denaturation temperature indicates greater protein integrity and provides an indication of the strength of internal fiber bonds. Damaged hair loses its integrity which, in turn, lowers the denaturation temperature. KA's have been shown to increase the denaturation temperature of damaged hair through treatment with the shampoo and conditioner system relative to hair treated with non-conditioning shampoo (Fig 1) containing no Keratin Actives. This observation is proposed to be due to these penetrating molecules interacting with damaged protein within the cortex and changing the local balance of electrostatic interactions forces and strengthening the internal bonds.

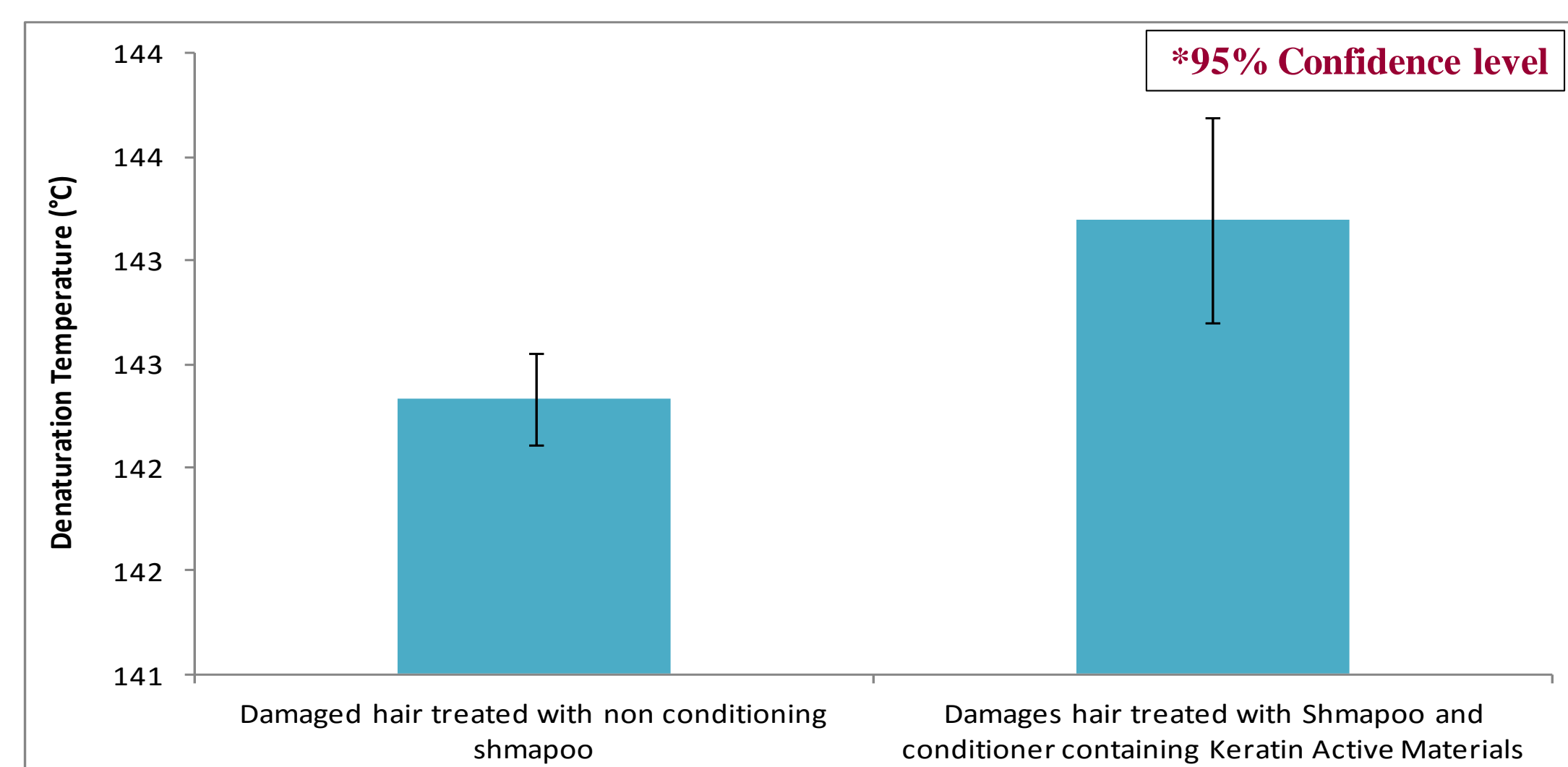


Fig 1 : Keratin Active materials significantly improves the Denaturation temperature of chemically damaged hair

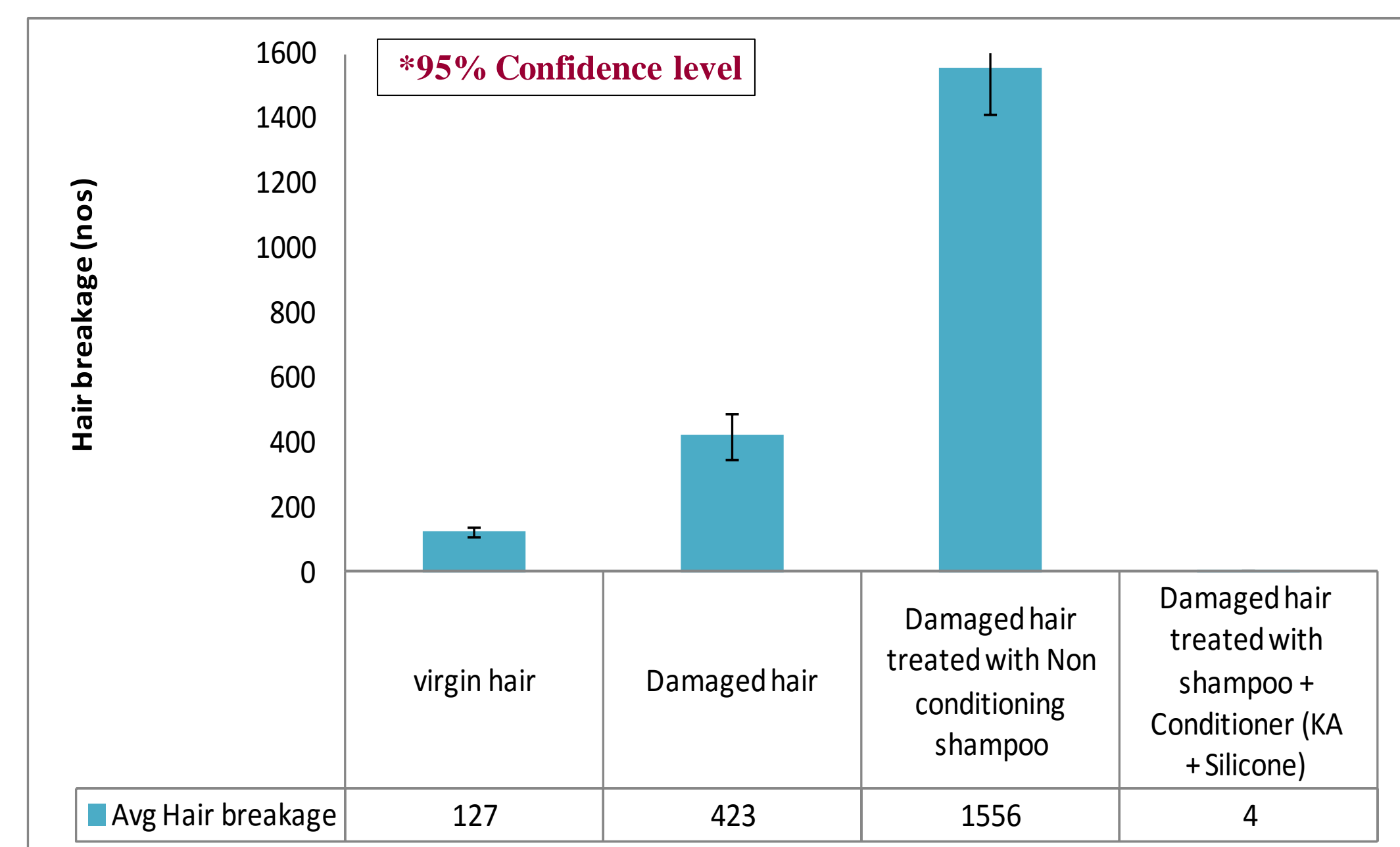


Fig 2 : Hair Breakage of chemically damaged hair is significantly reduced by the use of shampoo and conditioner (KA + Silicone)

### Hair Combing Rig (HCR)

The HCR results indicate a lower number of broken fibers for damaged hair treated with the shampoo and conditioner system when compared to the non-conditioning shampoo (Fig 2 & 3). Bleached and heat damaged hair possesses weak bonding within the hair cellular structure, which only weakens further with regular grooming practices like combing, and results in more hair breakage. Shampoo and conditioner containing KA and silicone technology, in addition to repair of hair, are shown to protect the hair fiber from further damage.

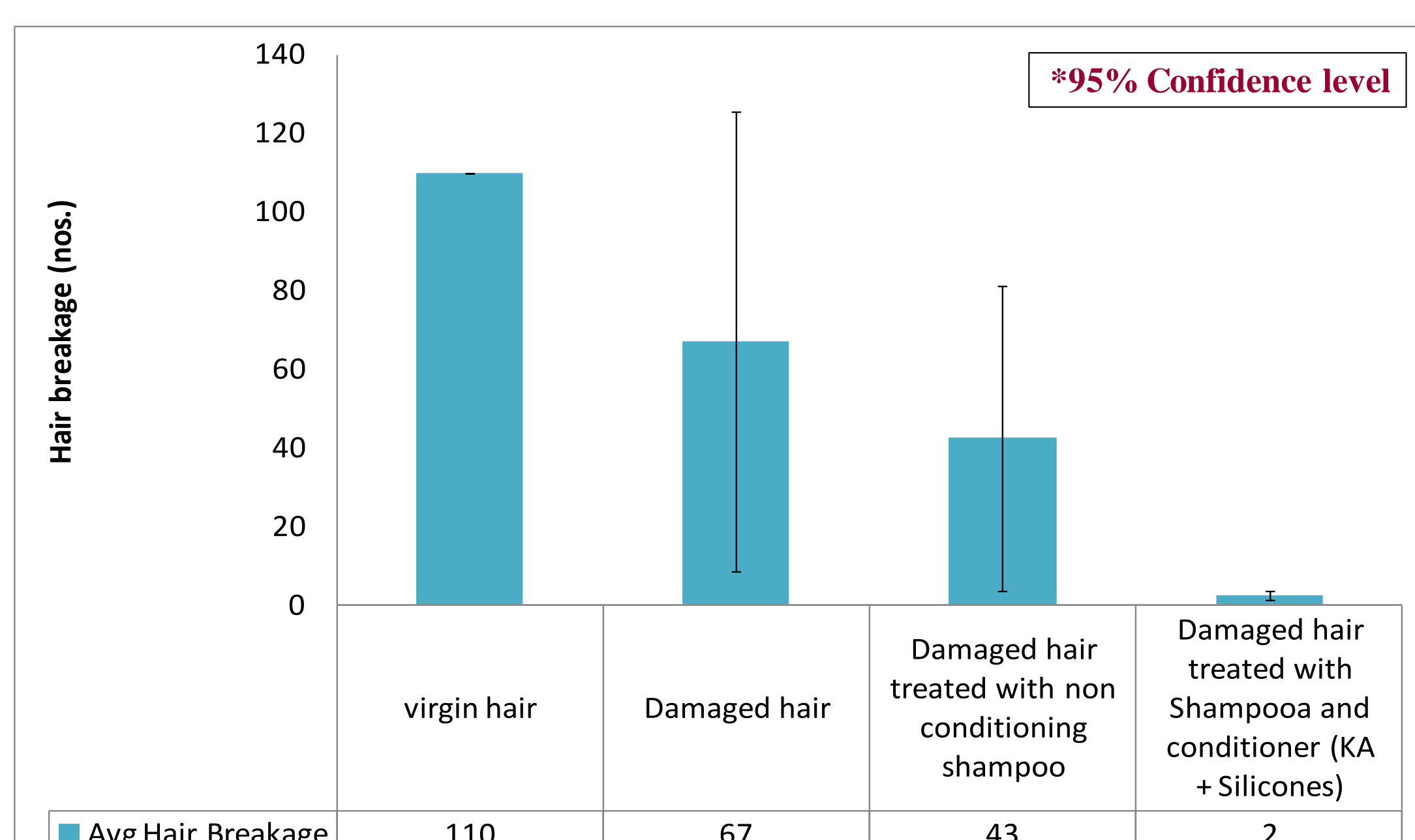


Fig 3 : Hair Breakage of hot-ironed damaged hair is significantly reduced by the use of shampoo and conditioner (KA + Silicone)

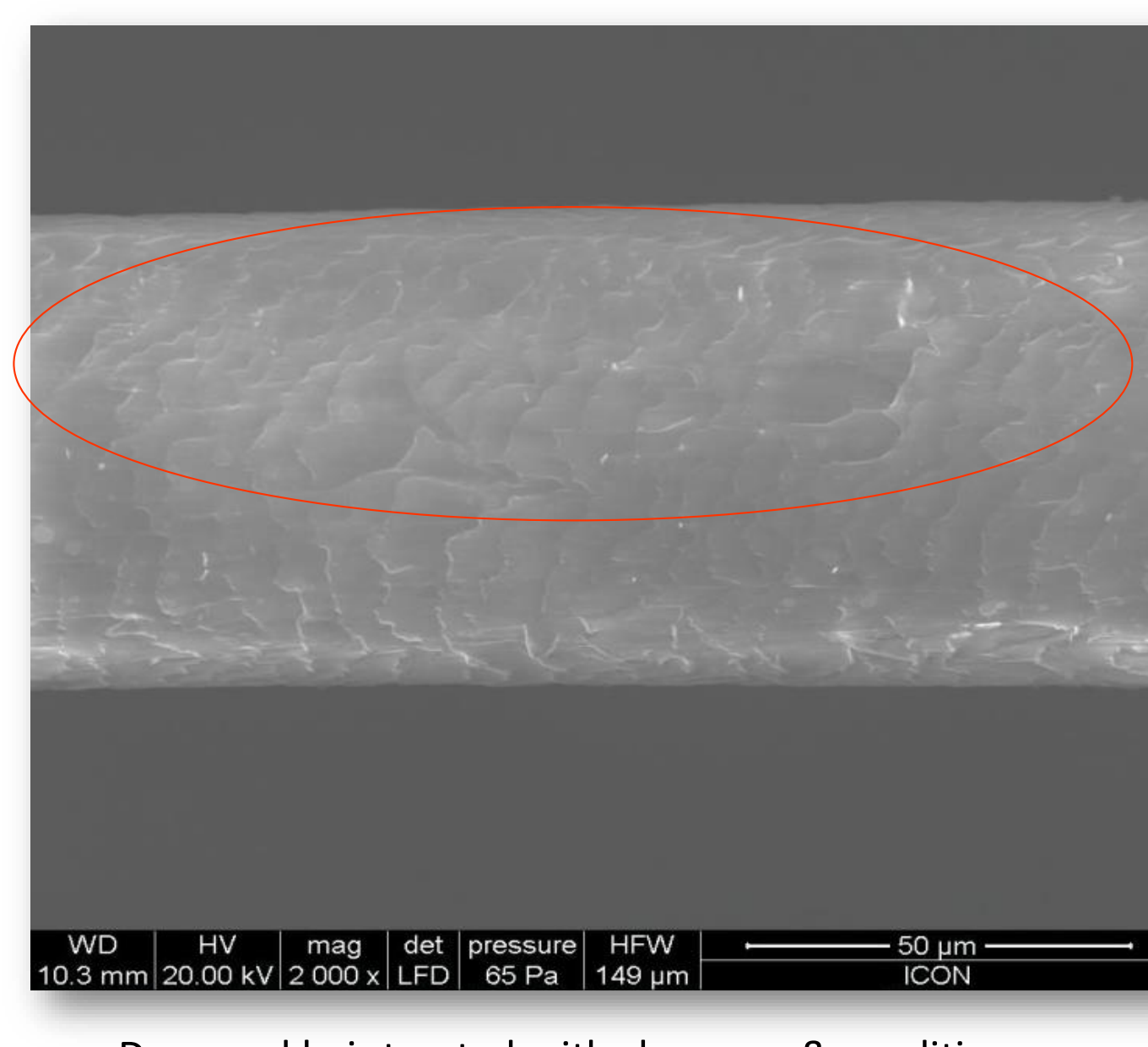
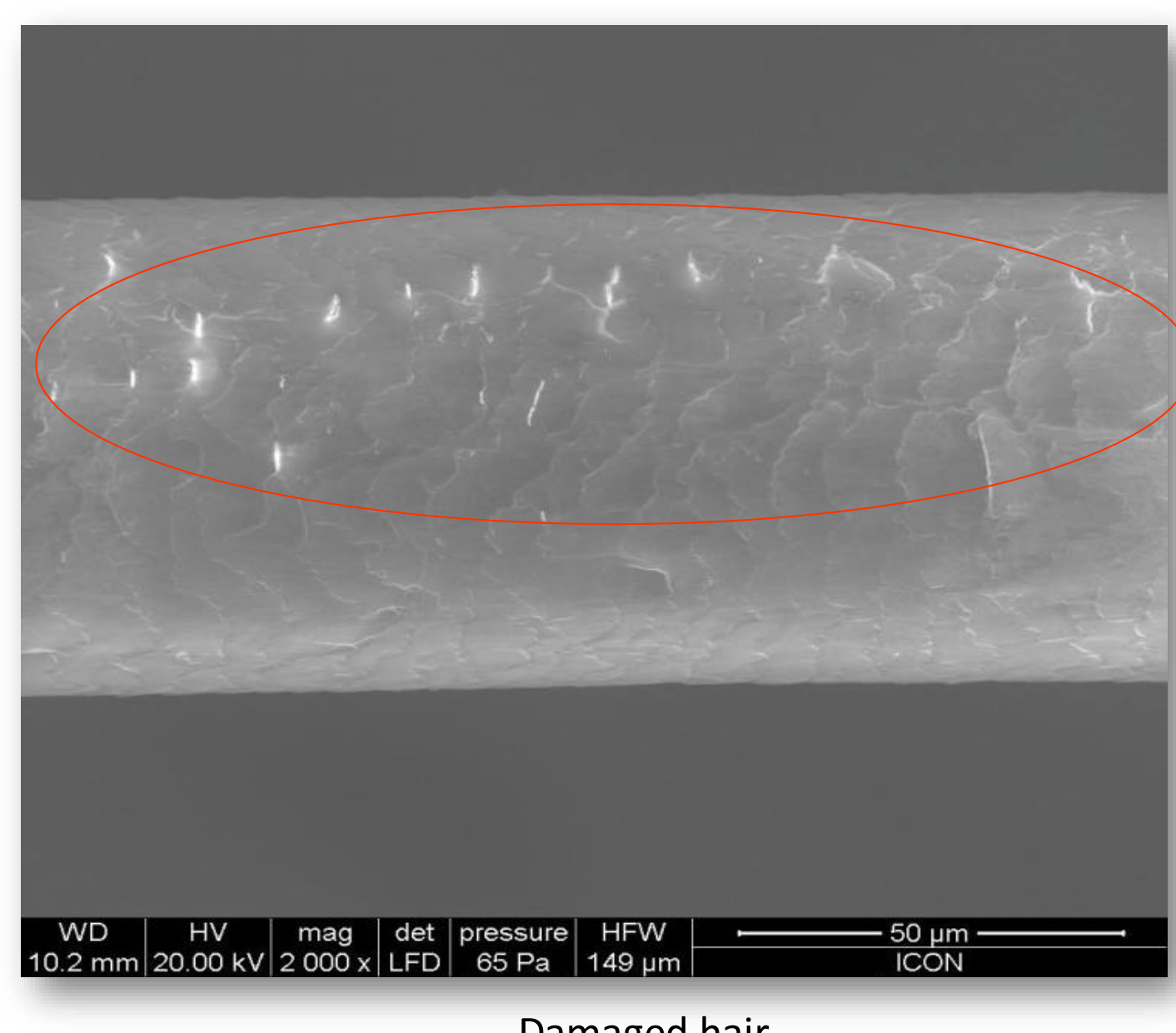
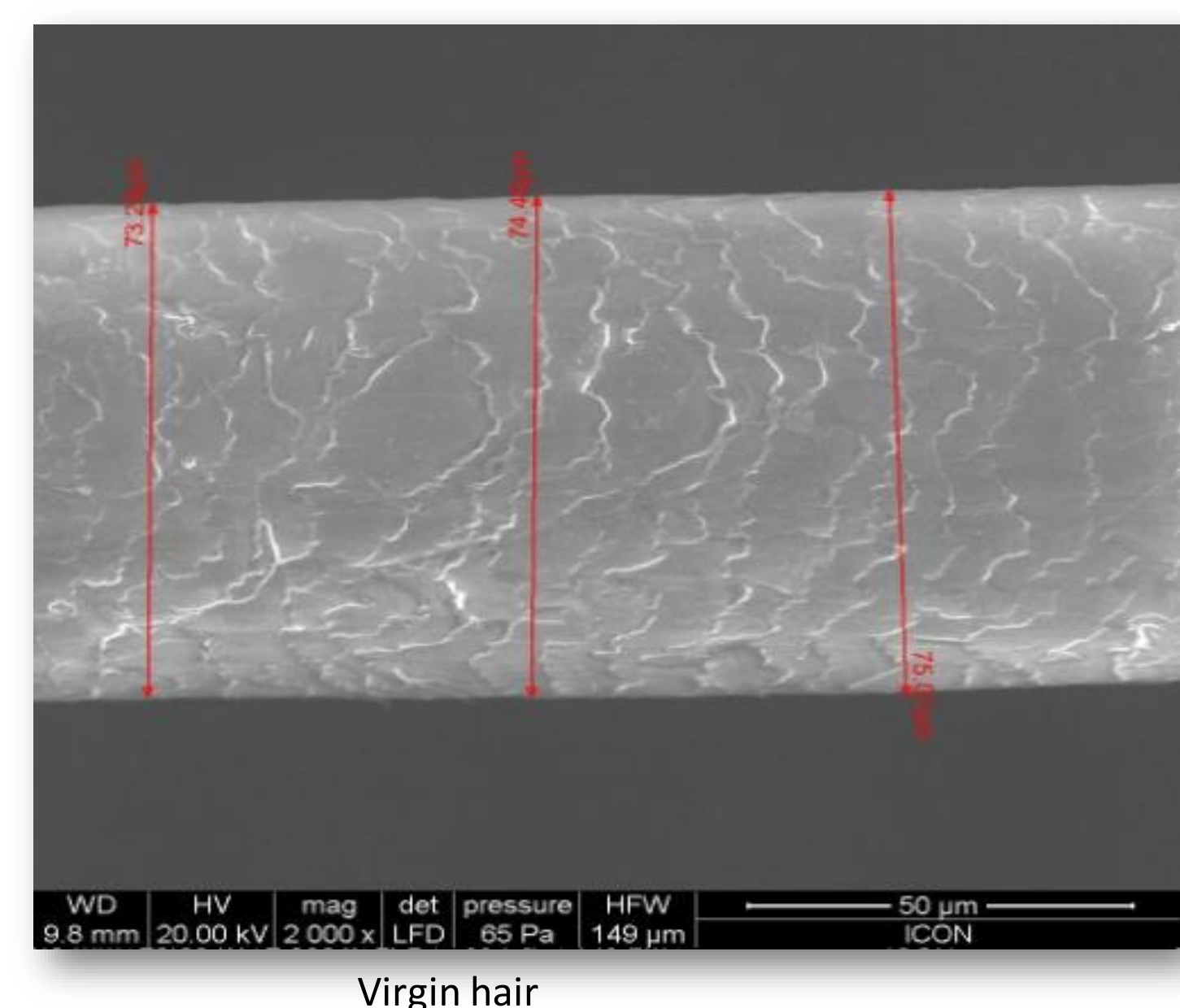


Fig 4: SEM images reveal the repair and filling of cracks and up lifted cuticles in damaged hair treated with shampoo and conditioner (KA + silicone)

### Scanning Electron Microscopy

The topographical examination of untreated, damaged hair & damaged hair treated with shampoo and conditioner is shown (Fig 4). SEM shows that damaged hair possesses many cracks which eventually makes it more prone to breakage, these observations are in line with the published literature S.B. Ruetsch *et al*<sup>[6]</sup>. Whereas damaged hair treated with shampoo and conditioner containing silicone and KA materials fills/repairs the cracks and lifted cuticle and contributes towards the overall improvement of the hair properties.

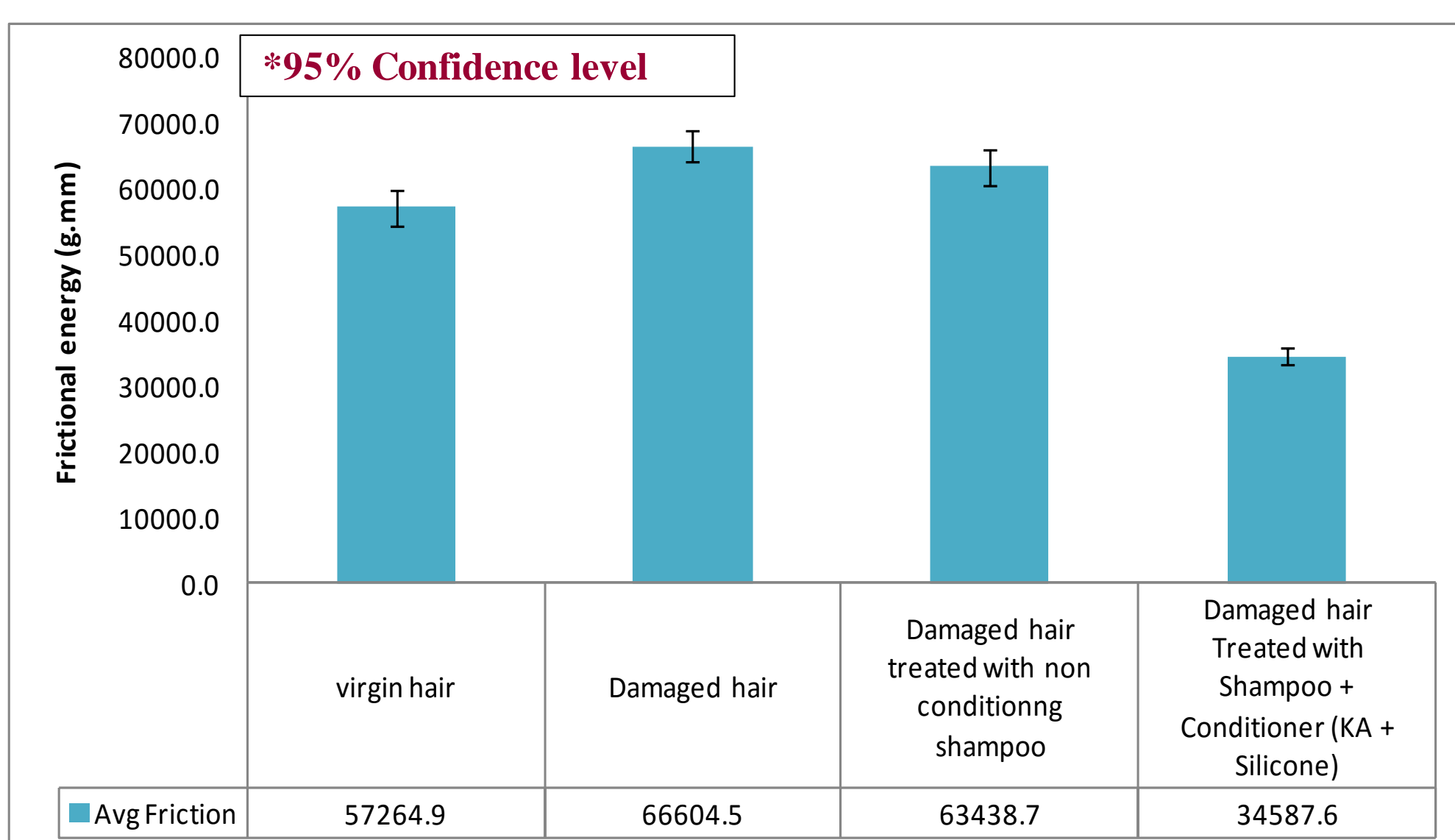


Fig 5: Surface smoothness of chemically damaged hair significantly improves when treated with shampoo and conditioner (KA + Silicone)

### Texture Analysis (TA)

The abrading of cuticle through chemical and heat damage results in higher frictional energy at the hair fibre surface and contributes to the hair feeling rough. This evaluation clearly reflects that damaged hair treated with shampoo and conditioner system has a lower friction coefficient when compared to a non conditioning shampoo treatment (Fig 5,6). We show here that the deposition of the silicone technology through the shampoo and conditioner system significantly reduces the friction coefficient, meaning increased smoothness and a demonstration of the surface repair benefit.

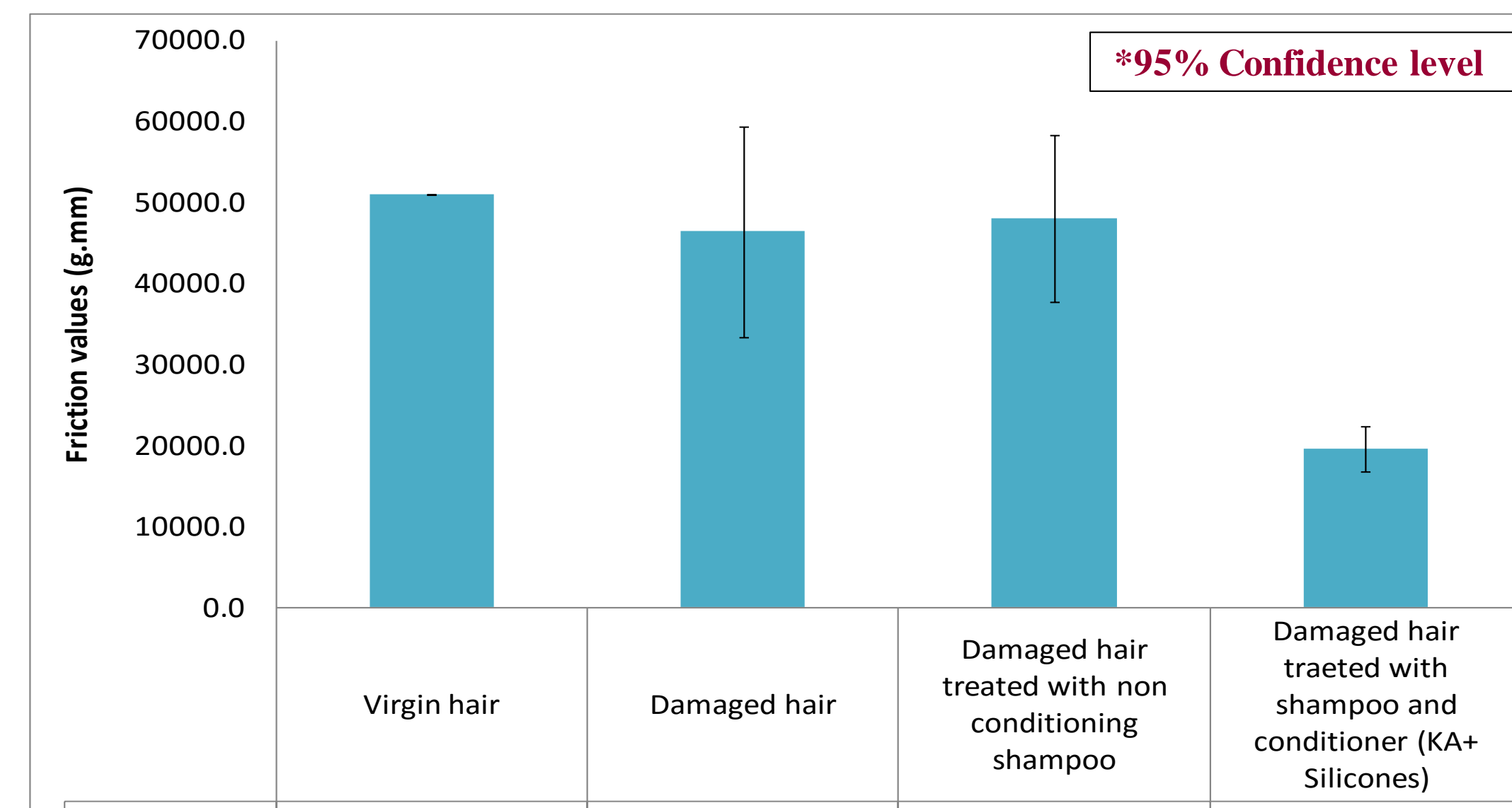


Fig 6: Surface smoothness of hot-ironed damaged hair significantly improves when treated with shampoo and conditioner (KA + Silicone)

## Conclusion:

Chemically damaged hair and heat damaged hair has been shown to be repaired through the use of shampoo and conditioner containing Keratin Active technology and surface repairing & protecting silicone technology. Keratin Actives strengthen the protein integrity of the damaged hair and silicone technology influences the surface repair and its protection against further damage. DSC has shown an increase in the denaturation temperature of damaged hair treated with the system demonstrating the KA benefit. Analysis of hair breakage data has shown that treatment with the system protects and reduces hair breakage, indicating an increase in strength, when subjected to repeated combing. These results are in correlation to the DSC observations which establish the improvement in the strengthening of the internal protein bonds. The surface smoothness has been observed by friction analysis to have improved and these changes to the surface are in line with the electron microscopy observations.

## References:

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