First evaluation of coated Constantan wires comprising ***Capuchin knot*s** to increase anomalous heat and reduce input power at high temperatures.

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Abstract

Anomalous Heat Effects (AHE) have been observed in wires of $Cu_{55}Ni_{44}Mn_1$ (Constantan) exposed to H_2 and D_2 in multiple experiments along the last 8 years. Improvements in the magnitude and reproducibility of AHE were reported by the Authors of the present work in the past and related to wire preparation and reactor design. In facts, an oxidation of the wires by pulses of electrical current in air creates a rough surface featuring a sub-micrometric texture that proved particularly effective at inducing thermal anomalies when temperature exceeds 400 °C. The hunted effect appears also to be increased substantially by deposing segments of the wire with a series of elements (such as Fe, Mn, Sr, K, via thermal decomposition of their nitrates applied from a water solution). Furthermore, an increase of AHE was observed after introducing the treated wires inside a sheath made of borosilicate glass (Si-B-Ca; *BSC*), and even more after impregnating the sheath with the same elements used to coat the wires. Finally, AHE was augmented after introducing equally spaced knots (the knots were coated with the mixture of Fe, Mn, Sr, K) to induce thermal gradients along the wire (knots become very hot spots when a current is passed along the wire). Interestingly, the coating appears to be nearly insulating and it is deemed being composed of mixed oxides of the corresponding elements (mostly FeO_x, SrO). Having observed a degradation of the *BSC* fibers at high temperature, an extra sheath made of quartz fibers was used to prevent the fall of degraded fibers from the first sheath; recently the 2 sheaths assembly has been replaced with a hybrid single sheath developed by SIGI-Favier (i.e. made of both glass and quartz fibers). The treated wire, comprising knots and sheaths, was then wound around a SS316 rod and inserted inside a thick glass reactor. The reactor operates via direct current heating of the treated wire, while exposing it to a 5-2000 mBar of D_2 or H_2 and their mixtures with a noble gas (*in these conditions electromigration phenomena are supposed to occur*). In 2014, the Authors introduced a second independent wire in the reactor design and observed a weak electrical current flowing in it while power was supplied to the first. This current proved to be strongly related to the temperature of the first wire and clearly turned to be the consequence of his *Thermionic Emission* (where the treated wire represents a *Cathode* and the second wire an *Anode*). The presence of this thermionic effect and a spontaneous tension between the two wires did strongly associate to AHE. All these observations were reported at various Conferences, and tentative explanations were provided for the observed effects. The presence of thermal and chemical gradients has been stressed as being of relevance, especially when considering the noteworthy effect of knots on AHE. The ICCF21 Conference held on June 2018 marked a turning point, and the scientific community did show a notable interest on the effects of knots and wire treatments, further increasing the confidence on the described approach. From that moment, attempts to further increase AHE focused on the introduction of different types of knots, leading to the choice of the ***"Capuchin"*** type (see fig.). This knot design leads indeed to very hot spots along the wire and features three areas characterized by a temperature delta up to several hundred degrees. Efforts were also made to better understand the thermionic effect of the wire, and the spontaneous tension that arises when a second wire is introduced close by (anode). Eventually a large AHE rise was noticed when introducing an extra tension between the active wire (cathode) and the second wire (anode) through an external power supply; a truly remarkable effect, despite his short duration due to the wire failure attributed to an AHE runaway able to melt it. Eventually the authors have observed a stunning similarity of the best performing reactor design and a thermionic diode where the active wire represents the cathode and the second wire the anode, whereas the electrodes are separated by fibrous layers impregnated with mixed oxides comprising Iron and alkaline metals. This observation allows to speculate on a thermionic power converter able to generate electricity through the thermionic emission of a cathode heated by AHE and collected by an anode (colder and/or featuring a different work function with respect to the cathode). The presentation, summarized in this abstract, reports the latest AHE results obtained from a new reactor design comprising capuchin knots and hybrid sheaths manufactured for the purpose.

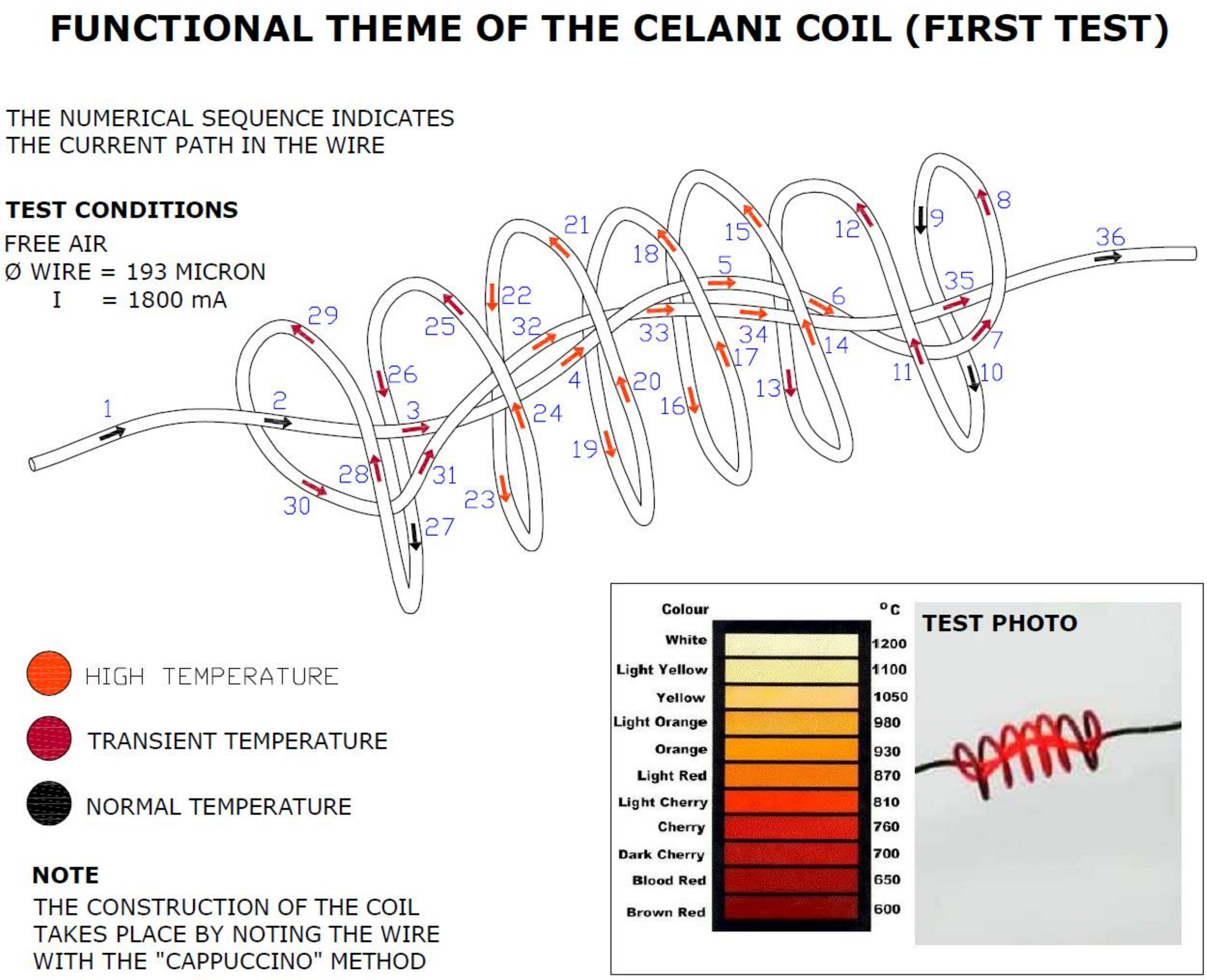

Fig. 1 Photo, in DC, I=1900mA, of a piece of Constantan wire having a diameter of 193 µm. Capuchin knots with 8 turns. Temperatures estimated by color. The dark area is at temperature <600°C, the external helicoidal section is at about 800 °C, the inmost section, linear, up to 1000 °C in some areas.