Carbon copying the 'Stradivarius' sound

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(PhysOrg.com) -- It's every violinmaker's dream to produce an instrument to rival the sound of a Stradivarius but now researchers at The University of Nottingham are trying to do just that… using acoustic physics and carbon fibre engineering.

The scientists at the University's Department of Mechanical, Materials and Manufacturing Engineering have developed a carbon fibre violin which could revolutionise the classical stringed instrument industry. Violins are traditionally made of wood using techniques and designs that are hundreds of years old but this new project aims quite literally to create a 'carbon copy' of the top-grade wooden instrument.

Some modern stringed instruments have been made out of composite materials including a carbon fibre laminate, but the scientists say little significant research has been carried out on how to create a consistent, high-quality sound with robust and hardwearing manmade materials. Special Professor John Dominy has been working with violin-maker Peter Killingback and a team of researchers to produce a prototype carbon fibre violin which he has just unveiled at the International Conference on Composite Materials in Edinburgh.

Over the past year Professor Dominy has been leading a programme of highly experimental and analytical work to develop an instrument with vibration and acoustic characteristics to match a high quality traditional violin. Even the best wooden instruments have drawbacks; they are extremely fragile and also very sensitive to humidity and temperature. The team believes that a carbon fibre-epoxy resin composite would be a

cheaper and more reliable material, with a much faster manufacturing time. The shape of the prototype carbon fibre instrument has been modeled on the famous 'Lord Wilton' Guarneri violin which was made in Cremona, Italy in 1742.

Professor Dominy said: “There's been much research over the years on how modern wooden violinmakers can reproduce the sound of the Italian masters of the 17th and 18th centuries, but almost none on the serious use of alternative materials like carbon fibre at the high end of the market. Our prototype is already impressing violinists who've tried it. We now want to continue testing to ensure a top quality violin with an excellent sound before joining forces with a local manufacturer to test the market.”

The violin project has been funded by the Nottingham Innovative Manufacturing Research Centre (NIMRC), based at the University. It has taken nine months of painstaking research to develop with help from specialist manufacturer Carbon Concepts Ltd. The team developed a testing strategy to compare sound vibrations from a wooden violin with their carbon fibre copy. This involved frequency spectrum analysis, Chladni nodal line testing (powder vibration) and laser vibrometer testing. Two carbon fibre front panels were tested; a twin-skinned 'sandwich' version with a balsa wood core, and a six-ply solid carbon fibre panel. The latter was judged to produce a better tone.

Professor Dominy's violin is made up of five carbon fibre parts; front panel, back panel, rib and left and right halves of the neck and peg box. (The wooden fingerboard was been retained so that the violin feels as normal as possible to the player). The component parts were produced by making a mould in MDF on a Computer Numerical Controlled milling machine using data measurements from the original Lord Wilton violin. The moulds were then rubbed down by hand, primed and spray-painted to give a highly polished finish.

Layers of carbon fibre 'fabric' impregnated with epoxy resin were laid into the mould and then vacuum-cured in an oven to set them. Hi-tech water-jet cutting techniques were used to produce the perfect 'f' shaped holes in the front panel. Each part was then machine finished and bonded together with epoxy adhesives.

Although the researchers are thrilled with the quality of their instrument they are now keen to improve it even further. Further work is being done on improving the manufacturing techniques and the sound by further investigation into the novel use of 'tuning plates' placed at specific points inside the front panel of the main body of the violin.

Provided by University of Nottingham (news : web)