A New Pentafluorophenyl (PFP) Core-Shell column to aid Selectivity

Ken Butchart, Mark Woodruff; • Fortis Technologies Ltd, Cheshire, UK

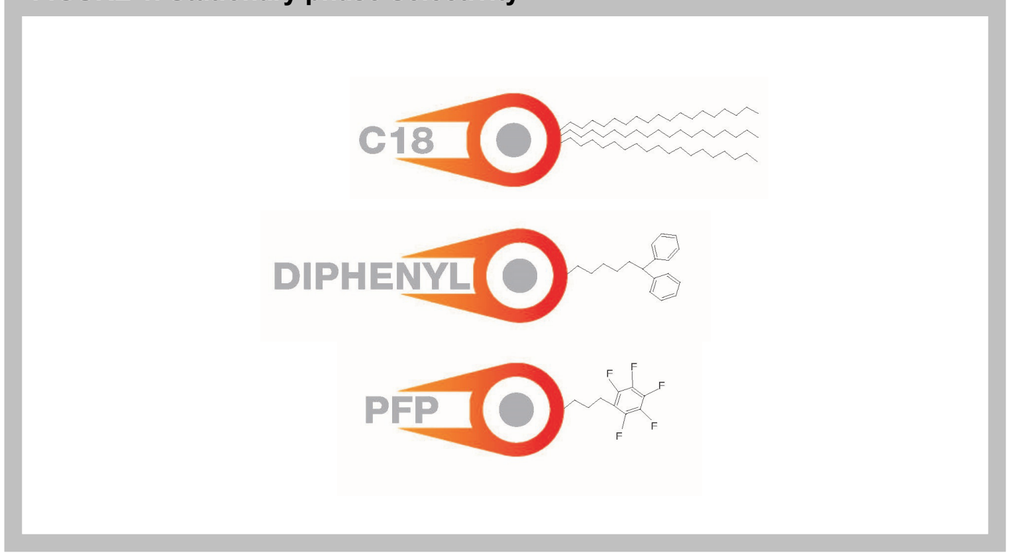
INTRODUCTION

In this poster we discuss the use of a new core-shell pentafluorophenyl (PFP) stationary phase for use in chromatographic separations. Whilst C18 and C8 alkyl chain stationary phases are the most common choice for starting method development, they cannot achieve all separations with required resolution, sufficient to achieve accurate qualitative results. The use of orthogonal stationary phases such as PFP allow differing mechanisms than just hydrophobicity to be utilised. In these examples pi-pi, electron donation and a steric term due to the differing nature of the ring structure are all possible.

Structure and Mechanisms

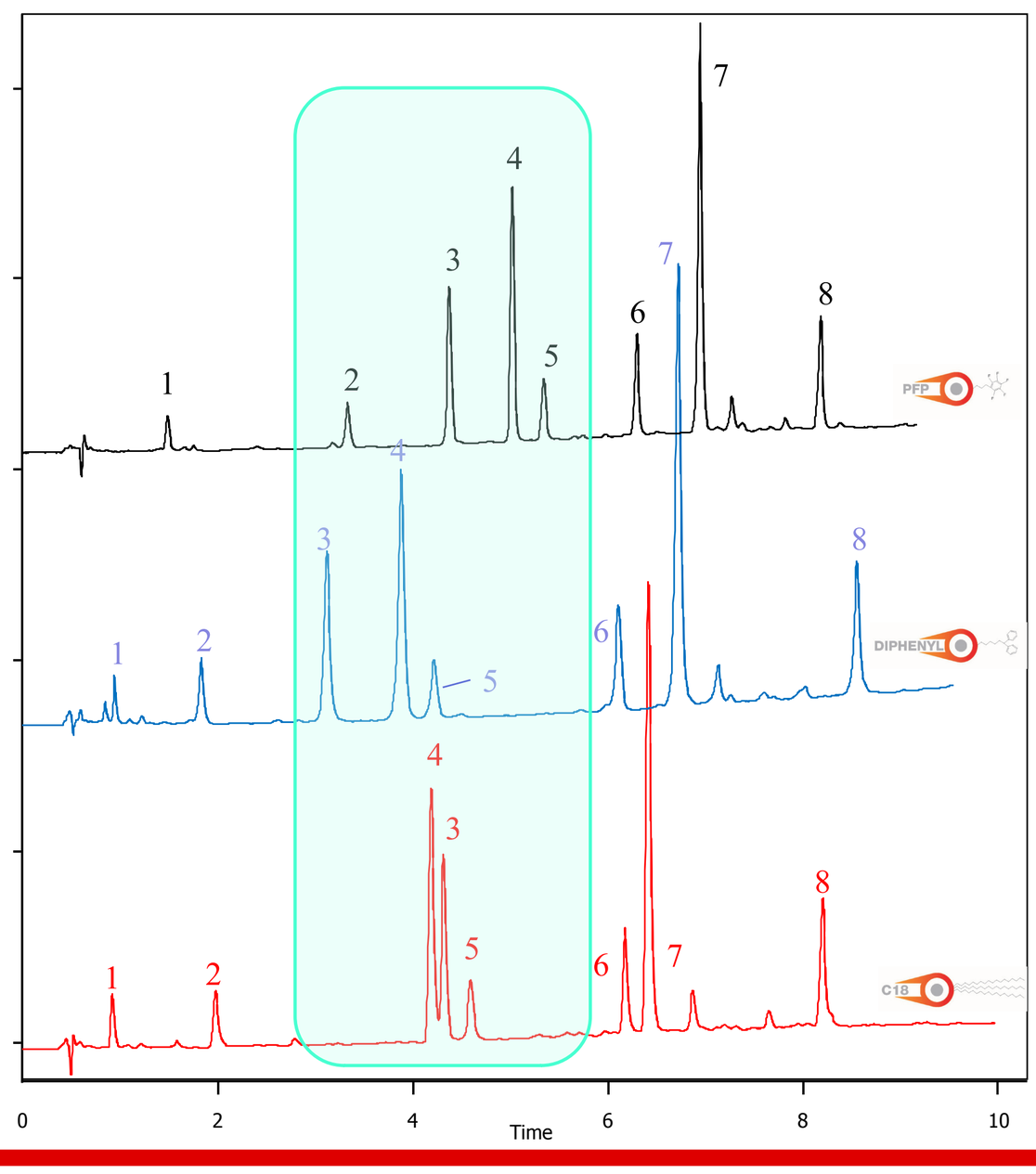
Whilst the majority of stationary phases in general use are based on L1, alkyl chain C18 chemistry, the ability to provide a different mechanism is paramount if suitable separation is to be achieved for closely related molecular species. A pentafluorophenyl structure bonded to silica provides an alternative mechanism from that of hydrophobicity on a C18 chemistry. PFP can provide pi-pi, dipole, steric, hydrogen bonding and hydrophobicity dependant upon the analytes structure, physiochemical properties and the mobile phase used.

FIGURE 1. Stationary phase Selectivity



When we analyse a diverse set of compounds in a mixture we can start to see some of these mechanisms come in to effect. Figure 2. highlights how even though the overall retention profile stays very similar for the eight analytes across all three stationary phases, and the early eluter (peak 1) and late eluters (peaks 6,7,8) have a very similar RT and selectivity, the middle of the chromatographic separation is heavily affected by the mechanisms occurring between analyte and stationary phase under the same mobile conditions.

FIGURE 2. Chromatographic Selectivity – Stationary Phase Choice



The selectivity of peaks 2-5 has the most resolution on the SpeedCore® PFP column under the same mobile phase conditions as the other stationary phases. This highlights how hydrophobicity of the method may be similar but the polarity, electron charge and steric terms are all playing a role in the orthogonal selectivity achieved.

Resolution

In Figure 3, we see how closely related alkaloids are resolved using the Speedcore® PFP stationary phase. Small changes in the physical nature of the analyte structures causes issues if only hydrophobicity is available, but the pi-pi and steric selectivity available on the PFP provide much greater resolution. The analyst will also be able to use buffer concentration as well as organic modifier to control retention factors of these dual mode selectivity's,

FIGURE 3. Caffeine Metabolites

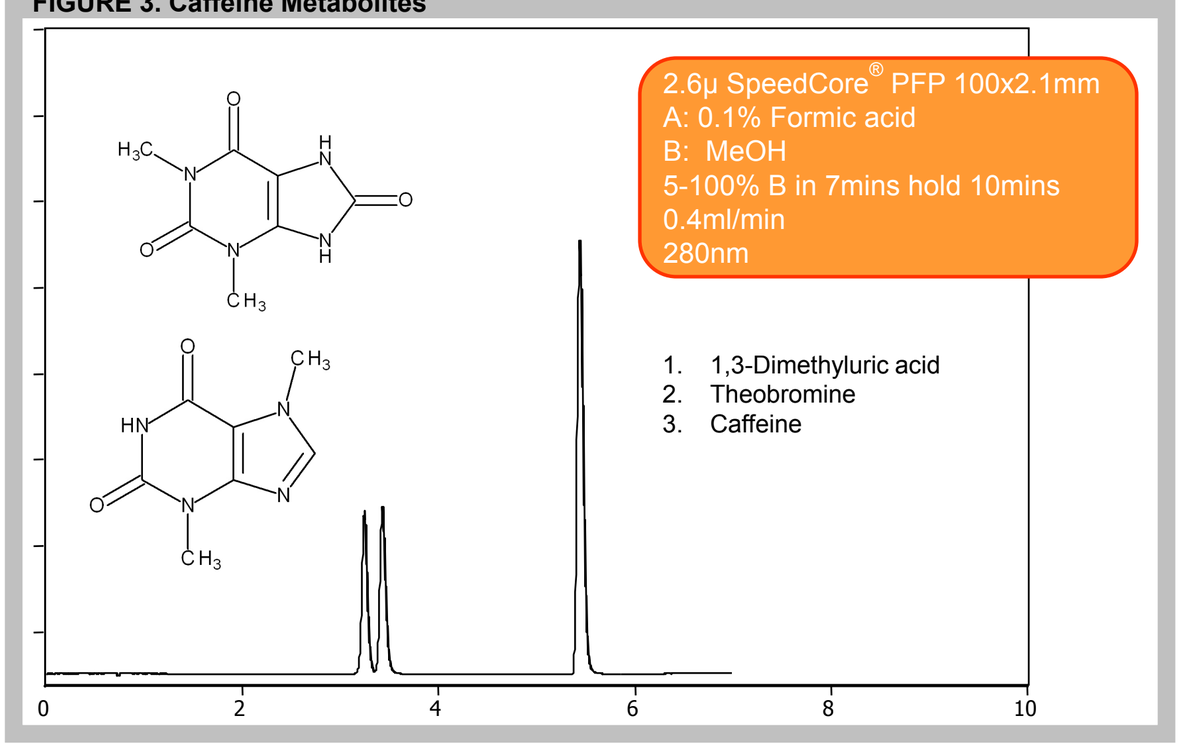
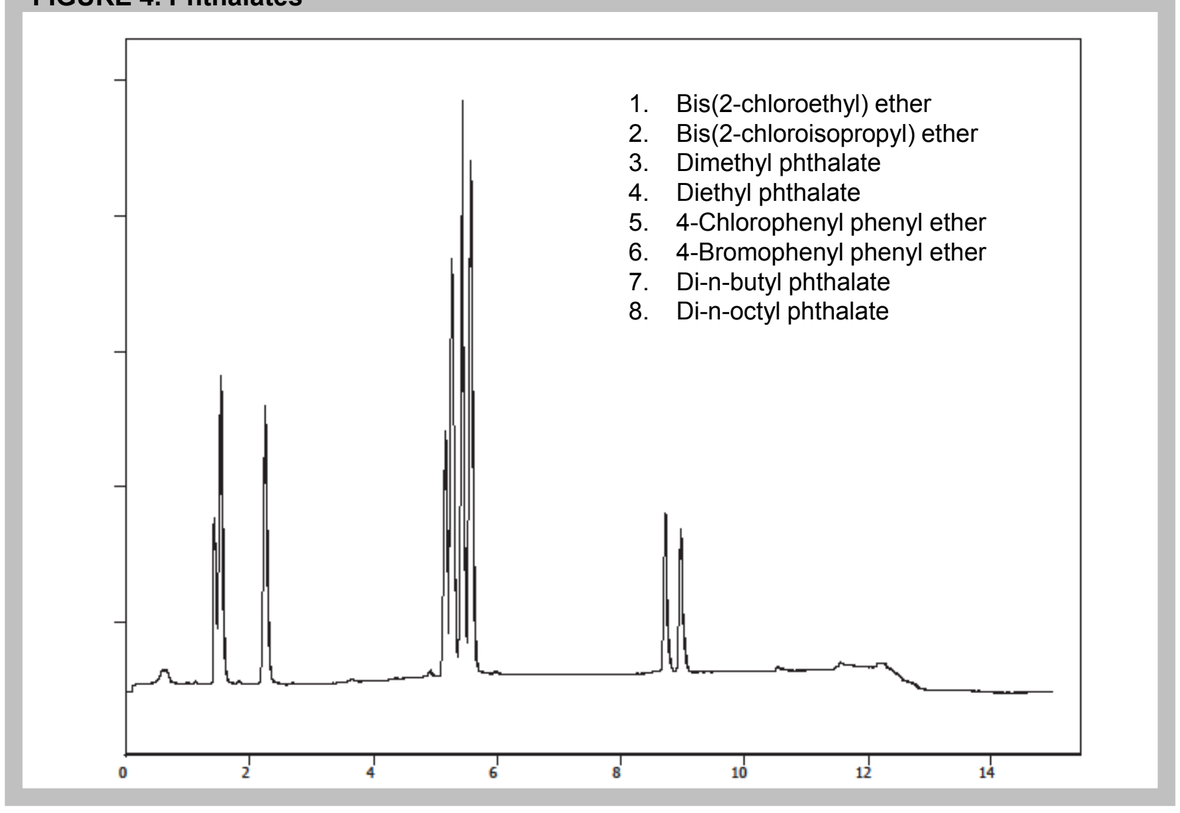


Figure 4. the separation of a phthalate mixture highlights how the high resolution of combining a core-shell particle with a orthogonal selectivity of a PFP bonding allows for excellent selectivity of closely related species. Making these phases particularly useful for isomer separations.

FIGURE 4. Phthalates



Conclusion

Core-shell technology has become the most talked about HPLC column technology in recent years. It provides high efficiency comparable to UHPLC small particle columns, but without the requirement for high pressure systems.
Even though the new core-shell SpeedCore® column provides very high efficiency, which in turn leads to higher resolution numbers, it is paramount that selectivity as a variable in the separation is not forgotten since this will provide a powerful method development tool. Having a wide variety of selectivity's available is essential on core-shell particles as we run faster analysis whether for method development or redevelopment of older QC methods.

In this poster we highlighted the orthogonal selectivity that can be achieved by the use of a pentafluorophenyl (PFP) stationary phase, which ensures that we not only have high efficiency separations but also high resolution separations.